THURSDAY, MAY 28, 1885

PRACTICAL INSTRUCTION IN BOTANY

A Course of Practical Instruction in Botany. By F. O. Bower, M.A., F.L.S., Lecturer on Botany at the Normal School of Science, South Kensington, and Sidney H. Vines, M.A., D.Sc., F.L.S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University; with a Preface by W. T. Thiselton Dyer, M.A., C.M.G., F.R.S., F.L.S., Assistant Director of the Royal Gardens, Kew. Part I. Phanerogamæ-Pteridophyta. (London: Macmillan and Co., 1885.)

IT is with more than ordinary satisfaction that we welcome this volume. Apart altogether from consideration of its intrinsic excellency, its appearance is gratifying as a first product of the younger school of botanists in this country—a school which for some years past has been doing good work in oral teaching, though up till now it has not contributed to teaching literature—and it is time that its methods were put in a more permanent form and made more generally accessible. The inconsistencies and inaccuracies characterising, with few exceptions, our endemic botanical text-books and our dependence for reasonably safe handbooks with information up to date upon translated works, mostly of German authors, are a reproach for which every botanist would gladly see the cause removed. At last we have a prospect of this, and the volume now before us is an instalment of a work which will in great part do so. The names of Thiselton Dyer, Bower, and Vines on the title-page are a guarantee of its thoroughness and accuracy, and the book certainly bears out their reputation.

The book took origin, as Mr. Thiselton Dyer informs us in the preface, in the work initiated by him at South Kensington in 1873. It is no small merit to have started at that time a system of instruction which embraced the examination by every student of the leading morphological facts of every important type in the vegetable kingdom. And this programme, which Mr. Thiselton Dyer set himself and successfully carried out, has not only eventuated in what, with him, we hope will be permanent—the institution, in what is now the Normal School of Science, at South Kensington, of a lectureship on botany, but also, in what concerns us here—this volume.

"I had always," says Mr. Thiselton Dyer, "hoped to put together the results of the experience in teaching methods acquired at South Kensington in the form of a handbook, which should save teachers who wished to follow our example from much of the trouble and difficulty which I, and those who at different times have taught in this way, have had to face. But, in the meanwhile, I had been drawn off to administrative duties which left a steadily decreasing leisure for purely scientific work. Fortunately, my friend Mr. Bower was willing—and with far greater competence—to take up the task which I was unable to perform, and to him are entirely due the laboratory instructions for studying the different types selected. Dr. Vines has very kindly supplied the chapters on methods and on the morphology of the cell. But besides this he has at every step given the assistance of his own extensive experience in practical teaching." With this book before us we can understand the motive of success of the South Kensington course, for it is the most thorough introduction to the practical study of plant morphology which has yet appeared; the only book to be mentioned along with it is the recently published "Practicum" of Strasburger—(of which of course the inevitable translation is promised)—and that is laid down on somewhat different lines.

In the first chapter Dr. Vines gives an excellent account of methods and reagents, delightful in the clearness and conciseness of its language and bearing throughout evidence of the hand of one who is no mere compiler of instruction but who has himself tested and had experience of all that is explained. The manner of setting to work, of making preparation, of making cultures, of preparing reagents, is all set forth in such a way that any intelligent tyro may readily equip himself and do good work. And we must congratulate Dr. Vines on the wise selection of methods and reagents he has made for notice, and on their arrangement. The multiplicity of new methods—many with but questionable advantage to recommend them—and their technicalities even in connection with botanical work is, at the present time, somewhat appalling and it is satisfactory to have these sifted by so competent an authority.

Dr. Vines's second chapter, on the Structure and Properties of the Cell, is a very prominent and commendable feature in the book, and will prove an extremely valuable one to all practical students—the micro-chemical portion of it especially, which gives in summarised and terse form the fundamental reactions exhibited by the various elements in the plant body, which are the basis of all further laboratory work. The student finds here at once a guide for testing the dictums of the earlier chapter as well as a graphic code for reference in his future studies. A synoptical arrangement such as this, and so happily worked out, has not been attempted in any previous book.

Mr. Bower's more especial work, the morphology of the various types dealt with, is no less excellent. The examples selected for illustration appear to us particularly well chosen, being readily obtainable in any locality, and their characteristics, macroscopic and microscopic, are explained with precision and in great detail. We shall not dwell at any length upon illustration of the admirable character of this part of the book, but in evidence of its completeness will refer to the section on the vegetative organs of Dicotyledons. *Sunflower* is selected as the chief type for examination, and we have first of all a brief description of the embryo and germination; then its stem in the mature and young condition are gone over, macroscopically and microscopically; but as it shows only the herbaceous type, the arboreous type as seen in *Elm* is explained, and further, the aquatic type, as in *Mare's-tail*. Sections are next added on the stem of *Cucumber* and *Lime-tree* with a view to special illustration of the sieve-tube elements, and upon *Dandelion* and *Spurge* for laticiferous elements. In like manner the leaf is treated of, to that of *Sunflower*, which is the chief type, descriptions of *Cherry-laurel* and *Stone-crop* being appended. Again, in the case of the root, *Scarlet-runner* as well as *Sunflower* is described. Besides these

forms we have mentioned, which are dealt with in detail, frequent references are made to other examples in which equally good or further illustration of special features may be obtained. Similar thoroughness runs through the accounts of all the types.

Every one perusing the volume must be impressed with the high standard of its educational value. Teacher and student in this country are alike to be congratulated upon its publication. The former has now a thoroughly trustworthy laboratory guide to place in the hands of pupils, and the latter has a handbook in his own language to which he can refer with confidence in his search after a sound knowledge of plant morphology.

This is only the first part of the work, and deals with Phanerogams and Pteridophytes. May the succeeding portion not be long in appearing! It is regrettable that the original intention of the authors "to preface the directions for the study of each type with a short account . . . of its salient morphological facts" has not been carried out in this part; Mr. Thiselton Dyer assigns in the preface the reason for its postponement. We are convinced that the want of such brief epitomes will be universally felt. But as the book is certain of a full measure of success, we look forward, with the authors, to the realisation of their hope that "the original scheme upon which the work was planned" may be "carried out in a future edition."

We conclude as we began by heartily welcoming the volume. We envy a student commencing to work with such a guide, and we are greatly mistaken if its effect is not very rapidly felt in the botanical teaching of the country.

THE PENNATULIDA OF THE NORWEGIAN NORTH ATLANTIC EXPEDITION

Den Norske Nordhavs Expedition, 1876–1878. *Zoologie Pennatulida*. Ved D. C. Danielssen og Johan Koren. (Christiania: Grondahl and Sons, 1884.)

THIS is the twelfth part of the series of monographs contained in this fine work, the first part of which was published in 1880. The former parts have dealt with, besides the chemistry and physics of the expedition, the fishes, a part of the Mollusca, the Gephyrea, Annelida, Asteroidea, and Holothuroidea, the monographs on the last four animal groups being by the same indefatigable naturalists who have produced the present memoir on the Pennatulida. The work is a highly creditable one to all concerned.

The present part is illustrated by twelve excellent plates, two of which are coloured, and which are in the same style as those already published by the same authors in their well-known memoir on new Alcyonians belonging to the Norwegian fauna published two years ago.[1] Thirteen species of Pennatulida belonging to eight genera were obtained during the expedition, and of these eleven species and two genera were new. One of the new genera is Svava, a small sea-pen with rudimentary fins and devoid of spicules on the sarcosome, cells and polyps. There is a stripe of zooids on either side of the stem, and in the two lateral canals of the stem are developed the zonads on the mesenteries of these zooids. The zooids alone produce gonads, the fully-developed polyps being barren. They are viviparous, the larvæ escaping from their mouths, as in Corallium. The other new genus, Gunneria, is founded on a fragment of a single specimen, but it is characterised by the presence of an immense quantity of spicules on the bodies of the polyps, their tentacles, and the sarcosoma, which latter forms a regular calcareous crust on the walls of the cells; the spicules are so closely packed in several layers that it is difficult to separate them, even with caustic potash. In this respect Gunneria approaches the Gorgonidæ; yet it is, nevertheless, a true Pennatulid.

The main feature of the memoir is, however, the part which relates to the now famous deep-sea Pennatulid, *Umbellula encrinus*, to which more than half the letter-press and seven of the five plates are devoted.

The Norwegian Expedition obtained twelve specimens of *Umbellula encrinus* from different localities. Kolliker described eight species of the genus from the *Challenger* collection, but one of these, *U. magniflora*, is considered by the authors as referable to the old historical *U. encrinus*, as are also Lindahl's new species from the Swedish Expedition of 1871, viz. *U. miniacea* and *U. pallida*. The whole of the twelve specimens obtained by the Norwegian Expedition are here carefully described in all details. All of them differ from one another, displaying peculiarities in various ages and stages of development which might, were the series less complete, easily lead to the establishment of separate species. The largest specimen obtained was dredged from a depth of 763 metres. It is a giant indeed. The rachis and the polyps, of which there are forty in the bunch, are twice figured on the last two plates, of actual size, coloured and uncoloured. The bunch of polyps occupies with its breadth nearly the entire length of the folio plate. The plates are far the finest representation of Umbellula yet published. There are eight prominent lanceolate areas occupied by zooids which extend up between the lateral polyps on the calicle-like part of the rachis, and spread themselves inferiorly over the rachis generally. The zooids are described as having each a single protusible tentacle, the tentacle when not retracted looking like a pendent papilla. These tentacles sometimes, but not always, bear short lateral pinnules, which are hollow, their cavities communicating with those of the tentacles, and which can be retracted with them. Kölliker, in his account of the *Challenger* Pennatulids, described similar zooids each bearing a single tentacle as existing in *Umbellula Huxleyi* and *U. Carpenteri*, and in the latter species found the single tentacles branched. He figures them, but only on a very small scale. On looking at the figures here given of these zooids (Tab. X., Figs. 56, 57) it is very difficult to understand their structure: the position of the mouth is not shown in any one, and they are drawn as elongate and flask-like in form when expanded, squat and rounded when retracted. The tentacle seems when protruded to be a direct narrow prolongation of the entire body of the zooid, and it appears as if on retraction this prolongation were telescoped into the basal region of the body. The base of the single tentacle should abut on one side of the mouth, but no such mouth-opening is figured. In the enlarged view of a zooid (Fig. 57) the mouth is neither definitely indicated nor referred to in the description. The text is not at all clear on the point.

[1] "Bergens Museum. Nye Alcyonider, Gorgonider og Pannatulider tilhorende Norges Fauna." (Bergen, 1883.)

The polyps bear the gonads, and are apparently viviparous. Very interesting conclusions are arrived at by the authors by comparison of the various stages at their disposal as to the mode of growth and successive additions of fresh polyps to the colony around the terminal primary polyp, and these are at variance with those of Lindahl. A couple of lateral polyps appear on each side of the terminal polyp, then another pair of laterals are formed, and the rachis expands in breadth. The centro-dorsal polyp is formed, and then the dorso-lateral are developed, whilst the lateral polyps become more numerous.

H. N. MOSELEY

OUR BOOK SHELF

A Flora of the English Lake District. By J. G. Baker, F.R.S., F.L.S. (London: George Bell and Sons, York Street, Covent Garden, 1885.)

IT is perhaps surprising that a "Flora" of the Lake district has not before been issued, considering the large number of botanists who have yearly rambled over its fells and dales. It has been left to Mr. J. G. Baker to do so, and with modesty he says "it does not seem likely at present to stand in the way of anything more complete." The limits of the "Flora" embrace parts of Cumberland, Westmoreland, and the whole of what is botanically called Lake Lancashire; but excludes "the northern half of Cumberland and the western slope of the Pennine Chain, through Cumberland and Westmoreland;" the exact boundaries are, however, not very clearly defined

One cannot help feeling, directly the book is opened, that it is the work of one used to generalise and deal with facts in a broad way: in no part more so than in the first fourteen pages, where, accepting Mr. H. C. Watson's definitions, he describes the distributive types, zones of altitude, temperature, &c., with a clearness coming of long and practical acquaintance with the subject, giving comparative tables of the types, &c., with those of Northern Yorkshire, Northumberland and Durham, and Britain, and making the Lake Flora about 900 species. It should, however, be remembered that this number is based on Mr. H. C. Watson's estimate of 1425 species for Britain as a whole.

Had that estimate to be made *now* by Mr. Watson, the result would probably be the accepting of a larger number, not alone by the discovery of species since made, but by a decided feeling on his part "that there were some species that would eventually have to be divided." It may well be asked *why* is there this comparatively large amount of difference demanded among our native plants to constitute a "species," and the little often accepted among newly-discovered "species" from distant countries; doubtless knowledge is progressive in the latter case, but still theories and generalisations are built up on them with as much apparent certainty as on floras long known and studied. Mr. Baker then enumerates the species constituting the flora, running up to 234 pages, numbering them according to the sixth edition of the "London Catalogue," showing also (but not numbering) the large number of doubtful plants that have at various times been reported from the district.

Perhaps the most striking fact brought out by this "Flora" is the scarcity of aquatic species compared with the numerous lakes and tarns, of which there must be between sixty and seventy, large and small. Whether in this particular district this is from the want of investigation, or from a real paucity of species or specimens, is difficult to say; but certainly our lakes and waters have not been sufficiently systematically searched, whether from the botanical, zoological, or chemical point of view. In this we should do well to emulate the Swedish naturalists; but in *our* case it may well be asked, "Where are we to look for help?"

How little we know of the life-histories of our aquatic plants! and it may well be suggested as a study for those botanists, who, while not being able to take up botany in the way so ably advocated lately by Prof. Bower in NATURE, still have some leisure from other occupations and duties, and could really advance the knowledge of our flora beyond mere collecting. It is only necessary to turn over the plates of Dr. T. Irmisch's work on them to understand what is meant and required.

AR. B.

The Fallacy of the Present Theory of Sound. By Henry A. Mott, jun., Ph.D., E.M., &c., Professor of Chemistry and Physics in the New York Medical College and Hospital for Women; Author of "The Chemist's Manual," "Was Man Created?" "Adulteration of Milk," "Testing the Value of Rifles by Firing under Water," "The Laws of Nature," "The Air We Breathe and Ventilations," &c. 12mo. (New York: Printed for the Author, 1885.)

THIS is a very curious book. Its author appends to his name recognised scientific titles, and seems to hold a responsible position as a teacher; but he has been led into a hopeless and inextricable muddle about wave-motion; and, starting with a misconception, he naturally obtains results so utterly at variance with common sense and experience, that it is remarkable he cannot see his error.

He begins by admitting that "to attack a theory which has been upheld for 2500 years, and which has been and is sustained by the greatest living scientists, is certainly a very bold undertaking." But he feels bound, nevertheless, "to come to the front and join Dr. A. Wilford Hall in exposing the fallacy." He fulminates, moreover, the following withering defiance at false prophets: "If Profs. Helmholtz, Tyndall, Lord Rayleigh, Sir William Thomson in Europe, and Profs. Rood and Mayer in this country, wish to retain the respect and confidence of thinking people, they will at once endeavour either to defend the theory of sound, or, like men, come boldly to the front and acknowledge that it is fallacious."

There can be no doubt that these various noblemen and gentlemen will at once proceed to adopt humbly the latter and safer alternative; because it is obvious that if they do not do so speedily, creation and nature will come to a premature end. This rather serious occurrence is thus predicted: "The lowest tone of an organ is stated by Prof. Blaserna to have sixteen vibrations to the second, and a consequent wave-length of 70 feet. It thus follows, says Dr. Hall, that in the sound of such an organ-pipe the air-particles (as a whole) are obliged to travel 35 feet and back sixteen times each second in order to pass from the space occupied by the centre of rarefaction to the centre of condensation and back. They would thus move with a velocity in one direction of 560 feet a second, or at the rate of 381 miles an hour, which would produce a tornado of more than double the velocity necessary to sweep a village into ruins. If there was the least truth in the wave-theory, the sound of a church-organ should get up a cyclone which would blow a cathedral into atoms."

This is truly very horrible! far worse than dynamite. Saddened by these reflections, we can bear with comparative equanimity the revelation that "the prong of a tuning-fork moves at the rate of only about one inch in four years," and "instead of swiftly advancing, as Tyndall says, sounds audibly when moving more than 25,000 times slower than the hour hand of a family clock, and more than 300,000,000 times slower than any clock-pendulum ever constructed, instead of very much faster, as Helmholtz teaches."

One more quotation is irresistible: "Imagine," says our author, who seems to have recovered wonderfully from the terrestrial cataclysm which he and the evil-doers

above named have all but provoked, "imagine a locust stridulating in the centre of a mass of iron one mile in all directions" (*sic*). The idea is charming, countrified, bucolic, but perhaps rather cold for the poor insect! "It is admitted he could be heard, and about sixteen times quicker than in the air. . . ." (the steps of this grand calculation must perforce be omitted). "The mass of iron thus displaced" (*i.e.* by said locust) "would weigh not less than 729,749,050,612 tons, and would be so moved by the strength of the locust."

The thought is too tremendous! so, locust-like, I must cease to "stridulate," lest I bring down the solar system in ruins on the heads of innocent humanity.

W. H. STONE

Kryptogamen-Flora von Schlesien. Vol. III.: *Pilze.* Bearbeitet von Dr. J. Schröter. (Breslau: J. U. Kern.)

DR. COHN's "Cryptogamic Flora" is already so favourably known by the portions which have appeared, that the announcement of any subsequent part is sure to be received with satisfaction. The first part of the Fungi, by Dr. J. Schröter, is just issued, and consists almost entirely of an introduction of nearly 100 pages, carefully digested and summarised, concluding with the order of classification adopted. The three groups or primary divisions are:—(1) Myxomycetes; (2) Schizomycetes; and (3) Eumycetes. The latter embraces the Chytridiei, Zygomycetes, Oomycetes, Protomycetes, Ustilaginei, Uredinei, Auriculariei, Basidiomycetes, and Ascomycetes, with an appendix for the incomplete Hyphomycetes, Tuberculariei, and Sphæropsidei. As the present part contains only a portion of the Myxomycetes, no opinion can be formed of the manner in which the foregoing skeleton will be filled up; but, as this portion is based upon Rostafinski's monograph, no exception can be taken thereto. The real difficulty lies further ahead, and whether the knot is to be untied or cut cannot be predicted.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

On the Terminology of the Mathematical Theory of Elasticity

I HAVE been greatly interested by the letters on this subject from Prof. K. Pearson (NATURE, vol. xxxi. p. 456) and Prof. A. B. W. Kennedy (vol. xxxi. p. 504), and I have looked forward with pleasure to further communications from other eminent "elasticians." As, however, no better qualified person seems disposed to continue the correspondence, and as I am practically interested in a definite settlement of elastic terminology, I venture to offer a few remarks on the subject.

(1) Nothing could be better than Prof. Pearson's term *state of ease* for the condition of an elastic body when capable of enduring a certain amount of stress, without showing permanent set on its removal. This is worthy of Clifford, and is sure to make its way.

Prof. Kennedy has extended this term by applying "maximum state of ease" to the condition in which the body may be strained to its elastic limit without set. Perhaps *ultimate state of ease* would be more significant, and *limited state of ease* might be employed to denote the intermediate stages. The ultimate state of ease of course corresponds to the "natural state" of the ideal perfectly elastic solid.

At the point B in Prof. Kennedy's figure we reach the *limit of perfect elasticity*, and enter the stage b of *elastic instability*. Prof. Kennedy's suggestion of "limit of stability" for the point C is inconsistent with the last. I would suggest *elastic crisis* as an alternative for "breaking-down point." We evidently here pass the critical point in the static equilibrium of the molecules.

Perhaps c' might be called the stage of *thermal inversion*.

At C_1 the bar enters the *plastic state*—divided by Prof. Kennedy into the *stage of uniform flow* from C_1 to the point D of *maximum load* and the *stage of local flow* from D to the point E of *terminal load* or (apparently) of *maximum stress*.

(2) I observe that Prof. Kennedy uses "load" and "external stress," apparently as alternative terms, and that Prof. Pearson speaks of "stress per unit area." Would it not be advisable to settle, once for all, that *stress* shall always, when it stands alone, mean a force per unit area? "Stress" and "intensity of stress" would then be identical terms, while the *force* across a given area due to stress would be known as the "total" or "resultant stress" across the area. This is all that is required to bring the terminology of *perfect* elasticity into exact correspondence with that of hydromechanics, in which pressure and total or resultant pressure have always stood in this relation to one another.

(3) Next as to "tension." The word was originally adopted from the theory of strings, and of bars used like strings to support weights, and was, I believe, invariably used (as it still is in the case of strings) to denote the load, or *total* longitudinal stress endured. Nowadays, however, it seems to be employed indifferently in this sense and in that of intensity of tensile stress. I would suggest that the term *traction*, which the modern French writers have freely adopted, should be invariably used to denote intensity of tensile stress, and that *tension* should be restored to its original signification of total or resultant traction.

"Traction" and "pressure" would then (according to the ordinary convention as to sign) be synonymous with "positive" and "negative" stress. Perhaps some elastician would suggest a convenient abbreviation for "total pressure" or "negative tension."

(4) Is it too late to protest on behalf of that much-abused term *viscosity* as applied to solids? The thoroughly-established sense of the word, as applied to fluids, implies—*not* the property in virtue of which they undergo permanent or continued change of shape under continued distorting stress (*i.e.* their *fluidity*); but that other property in virtue of which they are able to offer more or less resistance, by means of molecular friction, to instantaneous changes of shape under stress which is not continued. In this case, therefore, viscosity is a property distinctly opposed to fluidity, and, indeed, described in terms as a falling short of "perfect fluidity."

It is thus obviously false analogy to describe a metal in the state of plastic flow as *viscous*, or to "appropriate this name to that permanent set which may be produced by the application for a long period of a stress well within the limits of elasticity." The latter sense—at least as applied to ice (NATURE, vol. xxxii. p. 16)—has, no doubt, a classical authority in the great memoir of Forbes; but Sir W. Thomson has pointed out ("Enc. Brit.," Art. "Elasticity," § 31; and Thomson and Tait's "Natural Philosophy," § 741) that the properties of ice so described are included under the perfectly definite and convenient term *plasticity*, which is really analogous to fluidity.

On the other hand, analogy demands that the term *viscosity*, as applied to solids, shall be strictly confined to that frictional dissipation of energy which is always at work during rapid changes of strain, and which was first discovered during small vibrations within the elastic limit by Sir W. Thomson (*Proc. Roy. Soc.*, May 18, 1865, or the passages above cited).

That the viscosity of a ductile material is very greatly increased in the plastic stage is of course beyond a doubt, the amount of energy absorbed by it on sudden increase of the stress being so much in excess of that required to provide for the increased potential energy of the accompanying strain that the temperature rises to a sensible extent. But what I wish to make clear is that the true viscosity is not essential to or characteristic of the truly plastic state, but that, on the contrary, the viscosity of a ductile solid renders it *imperfectly plastic* in just the same sense as a viscous fluid is *imperfectly fluid*.

(5) Finally, I may perhaps be permitted to add that, next to the importance to all concerned of a definite and universal terminology, comes the importance to mathematicians at least of a uniform *notation*.

The effect of reading through, for purposes of comparison or historical record, the 100 odd *really important* treatises on this subject—in each of which a perfectly independent and generally

quite different notation is employed—is simply infuriating! I would urge upon Prof. Pearson that he has now an unrivalled opportunity of fixing in the language of English (and perhaps foreign) mathematicians a really serviceable and significant system of notation.

The double-suffix notation for strain and stress, which is developed to perfection in St. Venant's French translation of Clebsch, has many advantages, but seems to be too cumbrous for English taste. Nothing perhaps could be more unmeaning than Thomson and Tait's notation for "stresses," independent as it is of all reference to the strain-symbols. Still I must confess (in common, I dare say, with most men who have derived their first inspirations from that mathematical epic) that it has secured too firm a place in my mental machinery to be lightly cast out, even in favour of a better. W. J. IBBETSON

Cambridge, May 12

The Colours of Arctic and Alpine Animals

MR. R. MELDOLA has maintained, in NATURE, vol. xxxi. p. 505, the idea that the white colour of some animals, Arctic mammals and birds, must be ascribed to the absorbent and radiating power of the same colorations in relation to the rays of the sun. He maintains also that to a similar cause we owe the seasonal polychromism of several mammals and birds of the Alps, and what would be for these animals a partial return to the characters of the Glacial epoch.

By an analogous theory the author explains the contrary phenomenon that is observed in many insects—that is, the darkening of the coloration, and he speaks principally on this point of the Lepidoptera.

Now I beg to make the following observations, and to indicate the following facts:—

(1) That a seasonal mutation of colour is observable in many mammals, now more, now less distinctly, and generally it concurs with the change of coat. Also not seldom in mammals strictly belonging to the Alps, as, for example, in the *Rupicapra europea*, and in the *Capra ibex*, the colour changes very little in the summer and in the winter, although the length, the thickness, and also the coarseness of the hairs were very different. In other cases, as, for example, in the *Cervus mandarinus*,[1] the coat is, in summer, light reddish yellow, with many round white spots, while in winter it is dark brown, and the round spots are less numerous and are light brown.

(2) As to the insects, it is observed that in *Coleoptera* the colours of the Alpine species are brighter than those of the warmer plains, as in the genera of *Carabus*, *Pterostichus*, &c. In several species of *Harpalus*, *Amara*, *Cicindelis*, &c., the individuals that we find at the greatest elevations of the Alps have often lighter colours.

(3) A darker colour and sometimes a whole melanism is observed in general in the insects of the deserts—for example, in that of Sahara. On the contrary, the mammals of these countries present in general a very light colour. It seems to me that this fact cannot be explained by the theory of radiation.

(4) A very remarkable melanism is also observed in several mammals, the Reptilia and Coleoptera that are in little islands, or upon rocks in the warmest regions, for example the *L. muralis*, &c., *Cicindela campestris*, in the island of St. Peter in Sardinia.[2]

(5) In the reptiles and in the Alpine amphibia we sometimes meet with some cases of darkening, but the cases of a remarkable brightening are not very rare, as, for example, in the *tadpoles* of *Rana muta*.

(6) A sensible difference is observed in the coloration between the Arctic birds and the Antarctic. In these last black is much more abundant.

Indeed, Australia, New Zealand, &c., are countries known for a remarkable darkening in the colours of many sorts of animals.

In the Carnivora, which are the mammals that chiefly present seasonal polychromism and white colour, is observed a tendency to this colour in several forms that, however, do not live either in Polar regions or in very cold places. As to this fact the colour of the genera *Zorilla*, *Meles*, &c., and also the very curious *Ailurus melanoleucus* of Thibet,[3] should be observed.

The causes, I would say in conclusion, that intervene to modify the colour of animals, are very complicated; climate has amongst these a certain importance, but it does not seem to me that, although it be very attractive, Mr. Meldola's theory of radiation is sufficient. LORENZO CAMERANO

Zoological Museum of Turin

[1] Milne-Edwards, "Recherches pour servir à l'Histoire Naturelle des Mammifères," tav. 22, 22a. Paris: Masson.
[2] Si consulti L. Camerano, "Ricerche intorno alla Distribuzione dei Colori nel Regno animale." *Mem. R. Accad. Scienze di Torino*.
[3] Milne-Edwards.

On Certain Stages of Ocular After-Images

IN a short note in the *Phil. Mag.*, 1872, vol. xliii. p. 343, Prof. C. A. Young has recorded a curious instance of "after-image," which seems to me to be of the same order as that observed by Mr. Shelford Bidwell, and recorded in NATURE, (vol. xxxii. p. 30). I quote from Prof. Young's note, which is named "Note on Recurrent Vision," a few lines, which will show what his observation was:—

"In the course of some experiments with a new double-plate Holtz machine belonging to the College (Dartmouth, America), I have come upon a very curious phenomenon, which I do not remember ever to have seen noticed. The machine gives easily intense Leyden-jar sparks from 7 to 9 inches in length, and of most dazzling brilliance, at the rate of seventy a minute. When, in a darkened room, the eye is screened from the direct light of the spark, the illumination produced is sufficient to render everything in the apartment perfectly visible; and, what is remarkable, every conspicuous object is seen *twice* at least, with an interval of a trifle less than a quarter of a second—the first time vividly, the second time faintly; often it is seen a third, and sometimes (but only with great difficulty) even a fourth time."

Prof. Young shows that it is a subjective phenomenon, and measures the interval between the first and second seeing of an object, giving as the mean of twelve experiments the interval 0·22 second for the case of his own eyes, and 0·24 second for that of another observer.

Five or six years ago I observed another instance of what I believe to be the same kind of "after-image," though at first I was inclined, being engaged upon experiments with a view to finding the cause of certain ocular "ghosts" due to multiple reflection inside the eye (*Proc. Roy. Soc.*, No. 223, 1883), to ascribe it to a different cause. It was seen in a room lighted only by the bright glow of coals in the grate. Whenever the eyes were suddenly flashed across the fireplace, and then fixed on some object 50° or 60° from it, there appeared a faint blue light, which seemed to flash from the object to the glow. This phenomenon was much more strongly marked at some times than others, and varied with some cause which I never further investigated. Later I came upon another instance of the same thing; and as this is the easiest to reproduce, and one by which one may best study the phenomena, I will describe it.

Let a match or a splinter of wood be made to glow, as for testing oxygen, and let it be observed in a dark room; the eyes should be fixed, and the glowing match moved about. I found that for purposes of rough measurement a most convenient curve of motion is a figure of 8 on its side in a vertical plane (∞). Also it is convenient to keep the period of the movement the same, and to vary the size of the curve if change of velocity is required. There are difficulties to be overcome in regulating the brilliancy of the light (Mr. Bidwell has pointed out the necessity of a certain degree of brilliancy in the case of the vacuum tubes), if a systematic investigation were undertaken; a glowing match becomes brighter the quicker the movement; the reverse is the case with a platinum wire carrying a strong current of electricity; and a small incandescent lamp is objectionable on account of reflection from its glass case.

I shall consider the "after-images" of the glowing-point as forming a trail, in which all the changes are set out at the same moment, and proceed to describe the trail for two cases. I should state that following descriptions refer to the trails as seen by me *in the evening*; for there are very considerable variations in the phenomena according as the eye is likely to be wearied or fresh. I may also repeat Mr. Bidwell's caution that it is by no means certain that a person new to the subject will at first be able to see the appearances described.

I arrange a metronome beating seconds, and move the glowing-point so as to describe the curve completely in two seconds. First, let the figure of eight be only as large as can be got into a rectangle 3 inches by $1\frac{1}{2}$. In this case there comes after the glowing-point a dark interval in the trail, about an inch long; then a distinct blue-green ghost, about the same size as the

glowing-point; again a dark interval follows, shorter than the first, and behind it a long strip with a dark core and very faintly bright edges; as one traces backwards, the edges appear to close in together gradually, so that, after about two inches, the dark core has collapsed, as it were, and the edges have come together to form a narrow and well-defined thread of a mauve tinge; this gradually dies away as we go further back along the trail, and by the time that the glowing-point has travelled over the whole curve once, it has nearly disappeared.

Secondly, let the figure of eight be as large as can be described in a rectangle 8 inches by 4. Here the phenomena are quite different. It now seems as if the dark intervals at either end of the ghost as described above were absent, and the ghost itself were drawn out into a streak which follows *immediately* upon the glowing-point. Its colour is now yellow-green. This gardually narrows to extinction as one traces the trail backwards, and is the positive after-image in its various stages. More probably this streak has no connection with the true *ghost*; but is quite distinct from it, whilst the ghost no longer appears, when the point moves with greater velocity. In fact, there is probably a limiting velocity of the glowing-point, beyond which the ghost is not formed. This coincides with Mr. Bidwell's observations as to the rate of rotation of the vacuum-tube. As the yellow streak disappears narrowing, one sees a faint blue haze on either side, separated from it by an interval of darkness. When one has traced backwards so far that the streak has vanished, one sees what was above described as a strip with dark core and faint blue or mauve edges. The edges close in and form a distinct mauve thread, which gradually dies out.

It is very beautiful to see the ghostly trail hanging before one; and, by suitable movement of the glowing point, one may fill the space, as it were, with a maze of wreathing lines. Perhaps the most striking part of the phenomenon, regarded from an æsthetical standpoint, is the *depth* of the figures so produced: one realises in the form of the trail that the glowing-point has been moving, not in one plane, but in space; and one sees that some parts are nearer than others. After a time the glowing-point seems to be forgotten, and the trail is the only thing observed. The position of the trail appears to change with any change in the state of accommodation of the eye; if the trail goes away from one the eye attempts to follow it, and exaggerates the movement. If there is any irregularity in the curve, as may often be the case from want of proper co-ordination of muscles—especially if the moving arm is at all subject to rheumatism—it is revealed in a terribly truthful manner by the trail.

A systematic investigation of the subject would, I think, be very valuable as throwing light upon the processes in the retina.

Both Prof. Young ("whatever the true explanation may turn out to be, the phenomenon at least suggests the idea of a *reflection of the nervous impulse* at the nerve extremities, as if the intense impression upon the retina, after being the first time propagated to the brain, were then reflected, returned to the retina, and, travelling again from the retina to the brain, renewed the sensation") and Mr. Bidwell ("the series of phenomena seem to be due to an affection of the optic nerve which is of an oscillatory character," &c.) appear to incline to what I may call a *physical* view of the phenomena. The phenomena appear to me to point to some *chemical* action on the retina, and to depend in a great measure on the *rate* at which this action goes on. It would be of great interest to consider the phenomena in connection with Hering's theory of colour sensation; according to it these sensations are due to changes in a certain substance, in such a way that changes of a destructive or dissimilative character give rise to the sensations of white, red, and yellow, whilst those of a constructive or assimilative kind produce the sensations of black, green, and blue ("Zur Lehre vom Lichtsinne," Wien, 1878). It may be that this work has been already done; if so I must crave the indulgence of those who have made the subject a special study.

H. FRANK NEWALL

Crowthorne, Wokingham, May 18

"Speed" and "Velocity"

SOME of your "general" readers, like myself, may wish to see the distinction between "velocity" and "speed" more easily defined than by a reference to the calculus of quaternions, to which I believe the term "tensor" appertains.

"Speed" is not in the index to the new edition of Part II. of Thomson and Tait. Maxwell, at p. 26 of "Matter and Motion," says, "The rate or speed of the motion is called the velocity of the particle." Tate, in his "Properties of Matter," p. 52, writes about "water of motion; *i.e. Speeds.*" It seems thus:—

(1) Rate of motion is velocity (Maxwell)
(2) Speed of motion is velocity ,,
(3) Rate of motion is speed (Tate).

From (1) and (3) it appears as if velocity and speed must be the same, as indeed (2) seems to assert. But we are told this is not the case. Cannot the distinction between the two be made more generally intelligible than by saying that "speed" is the "tensor" of velocity.

SENEX

[When Maxwell introduced to junior students the *Diagram of Velocities*, he made velocity include the *direction* of motion as well as the mere *rate* of motion (*i.e.* speed).—ED.]

The Male Sole is not Unknown

IN last week's issue of NATURE is what is said to be an abstract of a paper read at the Society of Arts by Prof. Ray Lankester, in aid of a proposed marine laboratory, and, passing over what he stated generally requires elucidation, he gives one example of *what is not known among fishes*, and which in the first instance will be investigated at Plymouth. He is made to say "at present absolutely nothing is known as to the spawning of the sole—the male fish is not even recognised."

In times gone by the plaice was asserted to have ascended from a shrimp, but this, I think, is the first time that the existence of the male sole has been declined recognition. Omitting references to others, I will merely draw attention to the fact that in my collection of British fishes in spirit at the "Great International Fisheries Exhibition," and which is now deposited in the Economic Museum at South Kensington, is a fine example of the male sole, with the milt quite ripe.

I must apologise for pointing out the foregoing, but were such an error left unnoticed in a scientific paper, some practical fisherman will possibly direct attention to it, as the comparative rarity of the male to the female sole has been frequently observed upon in our weekly sporting journals during the last few years.

Cheltenham, May 23 FRANCIS DAY

The Aurora of March 15, 1885

NATURE for March 26 (p. 479) contains an account of a fine aurora observed at Christiania, Sweden, on March 15, by Prof. Sophus Tromholt. I would call attention to the fact that an aurora (a very unusual phenomenon at this place) was visible here on the evening of March 15. It was first seen at about 7 p.m.

At the above time several streamers were noticed ascending somewhat east of north: after a short interval these died leaving a white nebulous cloud of light at an altitude of about 10° near a point some 10° or 15° east of north. Shortly afterwards streamers appeared ascending some 10° or 15° west of north; these presently disappeared, leaving a mass of light similar to that left in the east of north. Several times feebler streamers made their appearance west of north. The rays did not attain a greater height than some 20°, and by 8¼h. all was quiet, save an auroral glow along the horizon some few degrees east of north, which remained throughout the night. I have thought this might be interesting in connection with the Christiania aurora.

Longitude west of Washington = 0h. 39m. 0·68s.
Latitude ... ... = +36h. 8m. 58 25s.

E. E. BARNARD

Vanderbilt University Observatory, Nashville, Tenn., U.S.A.

Catalogue of Fossil Mammalia in the British Museum. Part I.

IN reply to Mr. Lydekker's comments on the review of his work (NATURE, vol. xxxi. p. 597) I am glad to find that the author repudiates the Owenian system and its errors, though his recognition of the three upper premolars in *Vespertilio* as corresponding, respectively, to *pms.* 2, 3, and 4 of the typical series of four, and the minute anterior upper premolar of *Rhinolophus* as *p.* 3, added to the strange absence of any note on the presence of exceptions to the supposed rule that the premolars decrease in number by reduction from the anterior extremity of the series

would certainly lead any one acquainted with the subject to believe that he had acted on it. The only clues afforded by the work which indicate that the Owenian system was not adopted in its entirety, now pointed out by Mr. Lydekker as existing at pp. 152, 174, would certainly escape the notice of any one who had not actually spelled through the work, as I feel sure whoever will take the trouble to refer to will agree with me.

There is no evidence whatever to support Mr. Lydekker's assumption that the two anterior premolars in *Vespertilio* and the anterior premolar in *Rhinolophus* correspond, respectively, to *pms.* 2 and 3 and to *p.* 3 of the typical series. On the contrary, the small size of the second premolar in *Vespertilio* points to reduction by loss from the middle of the series, as we find in the greater number of species of the closely-allied order, Insectivora, and, as we know, takes place in the mandible of several species of Chiroptera.

With reference to the wish expressed in the review that, instead of writing a mere catalogue of the fossil mammals in the British Museum, Mr. Lydekker had undertaken one of all the known species, and his objection, while regretting that the intended friendly estimate of his capability for such a work has been so hostilely received, I maintain that such should have been undertaken; but Mr. Lydekker's remarks show how necessary it is, and that the objection that new genera and species are being made almost daily (it is probable that they will continue to be be made to the end of time) might be applied with equal force on behalf of the birds by Mr. Sharpe, who nevertheless continues his excellent catalogue. It is only by the publication of such a work that we can hope to limit the manufacture of "empty names," such as Mr. Lydekker objects to, and to reduce to order the vast amount of scattered information and contesting opinions which encumber the study of the subject.

THE REVIEWER

THE ORCHID EXHIBITION

THE Exhibition held in the Conservatory at South Kensington on the 12th and 13th inst. in connection with the Orchid Conference of the Royal Horticultural Society, must have furnished to the least observant visitor some explanation of the fascination exercised by orchids over their cultivators. The beauty, the variety, the strangeness of the flowers of the Orchideæ attract and interest the least enthusiastic even of the lovers of nature. But the variation in flower, compatible with botanical inclusion in one family, is not more marked than is the difference in mode of flowering and of growth. Could there be in one natural order a stronger contrast than between the mode of growth and the gorgeous flowers of the genus Cattleya—essentially "flaunting flowers"—and those of the genus Masdevallia, where the conspicuous part of the flower consists of the three sepals, drawn out in many species into thread-like tails many inches long, and ranging in colour through every shade of orange, scarlet, and purple, down to an almost inky black!

While a larger array of specimen plants has often been seen than was shown at the Conference, there has never been gathered together in any country so varied and interesting a collection, nor one containing so many rare and curious plants. Great as was the interest for the cultivator, it was no less great for the botanist. Mr. Ridley, of the Natural History Museum, who, in conjunction with Mr. Burbidge, of the Dublin Botanic Gardens, has undertaken to draw up a report on the Conference Exhibition, found that sixty-one genera of orchids were represented. For the first time in the history of flower-shows there was a numerous collection of hybrid orchids, raised by artificial fertilisation, in flower. For the first time was there a large collection of orchids in fruit. The progress of hybridisation, greatly due to the energy and skill of Messrs. Veitch and Sons and their intelligent foremen, Mr. Dominy and Mr. Seden, has already been fertile in valuable results for the cultivator. An excellent little book lately published,[1] gives a list of eighty-nine hybrids already in cultivation, distributed among twelve genera, but thirty-seven of them belonging to the genus Cypripedium. Those who are privileged to enter the penetralia at Chelsea know that there are there and elsewhere great numbers and varieties of hybrids, which are slowly surmounting the dangers and delicacy of infancy and childhood.

But the labours of the hybridiser promise to be of great value to the botanist. Mr. Harry Veitch, in his very suggestive and interesting paper on the "Hybridisation of Orchids," read at the Conference, says: "How will these bigeneric crosses affect the stability of the genera as at present circumscribed?" It is well established already that the genera Lœlia and Cattleya cross freely with one another, and Mr. Veitch refers in his paper to two other bigeneric hybrids, which have already flowered, and to others which have been raised, but have not yet flowered.

Unfortunately it must be a long time before orchid cultivators generally can enjoy the results of hybridisation. Mr. Veitch gives the time the hybridist must wait to see the result of his labours, as follows:—

Genus.	Time from Germination to Flowering
Dendrobium	3 to 4 years.
Phaius	About the same.
Calanthe	
Masdevallia	4 to 5 years.
Chysis	
Zygopetalum	5 to 9 years.
Lycaste	7 to 8 years.
Lœlia	10 to 12 years.
Cattleya	

With the exception of the genera Dendrobium and Cypripedium, it is a long time before sufficient plants of a hybrid can be obtained for distribution, even under the most skilful cultivation. For this reason many of the more beautiful hybrids will probably remain scarce and valuable for years. The high prices paid by collectors for orchids in some cases have been a source of merriment to the uninitiated. Speaking generally, orchids were never so cheap or so plentiful. But if a collector must have a hybrid which has been raised by skilful hands and nursed into vigour by years of patient care—or, on the other hand, must have a beautiful natural variety which has been picked out of millions of plants—if he must have them, he must pay for them.

The Royal Horticultural Society is to be congratulated both on the botanical and the horticultural results of the late Conference. The Conference was a new idea, a new departure. It has demonstrated the great, widespread, and, better still, the intelligent interest taken in a singular and beautiful natural order, and the skill brought to bear on its cultivation.

The short scientific contributions of Prof. Reichenbach, whose absence was universally regretted; the paper on "Hybridisation," by Mr. Veitch, and the brief discussion which ensued, were listened to by a large and appreciative conference. The paper on "Cultivation," by Mr. O'Brien, was also interesting and valuable. The very difficult question of nomenclature, which is in so confused and unsatisfactory a state as to ill brook delay, was postponed. It could not be discussed with advantage at the tail of a long meeting, and will be referred, it is to be hoped, to a a scientific committee selected from botanists in and out of the Royal Horticultural Society.

T. L.

WHEAT-PRODUCTION IN INDIA[1]

INDIA has recently exhibited her extraordinary powers as a wheat-producing area of vast extent. Up to the year 1877 the British wheat-grower looked upon the exhaustless prairies of the far West as his most formid-

[1] "Orchids: a Review of their Structure and History." Illustrated. By Lewis Castle. (*Journal of Horticulture* Office, 171, Fleet Street, E.C.)

[1] The Wheat-Production and Trade of India. Calcutta. Being a ollection of correspondence in continuation of papers published in 1879.

able rival in the matter of wheat-growing. A short seven years has greatly altered his feelings in this respect, and we are probably right in considering that the far East is destined to do its part in forcing down the price of wheat to as great a degree as the land of the setting sun. The *brochure* before us is a thoroughly dry statement of facts composed of numbered despatches, letters, and tables, all bearing upon the capabilities of India as a wheat-producing country. The reader will not, however, obtain information as to extent or area, except in a more or less incidental manner. The principal matters dealt with are (1) the quality and comparative values of the various wheats grown; (2) the modes of cultivation pursued; (3) the nature of the soils on which wheat is grown; (4) the average yield per acre; (5) the effects of continuous wheat-growing in diminishing yield; and also other matters relating to the details of wheat-cultivation in India.

With regard to the quality of Indian wheats there is no room for doubt. The conclusions arrived at are based upon actual weight per bushel, value upon the Corn Exchange at Mark Lane, and an elaborate report upon milling and bread-making results furnished by Messrs. McDougall Brothers of 10, Mark Lane, London. From whichever of the above points of view we test the quality of the Indian wheat, the result is equally satisfactory, and the more so when we find that from year to year the samples and bulk continue to improve. Messrs. McDougall Brothers go so far as to sum up their experience by saying, "glancing at all the facts, it is evident that these wheats afford a larger margin of profit both to the miller and baker than any other."

The modes of cultivation adopted are of great interest. They usually exhibit vast pains, and are in this respect superior to the system of wheat-cultivation employed at home. Such elaborate cultivation would indeed astonish an English farmer accustomed to plough his lea land or turnip land once for wheat. The comparison is less fair if we take into consideration the fact that one thorough English ploughing may be worth half-a-dozen of those "ticklings" of the soil which, under Indian skies, are sufficient to make it "laugh." Under the head of Systems of Cultivation we read:—"Ploughed in July, and again six or seven times until October. Watered in November. Again ploughed twice, rolled, ploughed again, and the seed sown through a tube attached to a plough-handle. After twenty-five or thirty days, again watered; and this is repeated until the plants appear fortnightly where irrigation is by lift, and every twenty-five days where it is by flow. In February, when the ears have appeared, water is given weekly until the ears begin to mature." In Armritsar;—"Six months before sowing, the land is ploughed five to ten times. After sowing, the crops are watered not less than six or more than nine or or ten times." In Gujrat:—"Land is broken up and ploughed many times between May and September, manured and ploughed and levelled." The average produce per acre after this system of cultivation varies from seven to fourteen or even twenty maunds (nine to twenty-seven bushels of 61 lbs.), and yet it is calculated that it is grown at from 8*s.* to 11*s.* per quarter! Wheat-growing appears to be carried on upon all sorts of soils. Upon stiff loams, sandy loams, hard clay, and "every kind of soil." In reply to the question, Has the productive power of the soil begun to fail? the answers are usually in the negative, or that it is not apparent. Still, as might be expected, better crops are grown upon manured and irrigated soils and upon those newly broken up from pasturage.

After reading the details of wheat-cultivation in India and compared its results with those obtained in England with a fifth part of the labour, we are inclined to wonder greatly that this remote field should be able to compete with us. Why do they plough five to ten times? How is it that in that sunny land, and after all this expenditure of labour and irrigation, twenty-seven bushels should be a maximum return, while in some cases seven bushels is all that is reaped? A painstaking farmer in England hopes for from thirty-two to forty bushels per acre after once ploughing and pressing his clover leys, and yet he cannot make both ends meet, nor yet compete with the Indian Ryot.

JOHN WRIGHTSON

THE REPORTS OF THE UNITED STATES COMMISSION OF FISH AND FISHERIES FOR 1881 *AND* 1882 [1]

THE Report for 1881 was presented to the Senate and Congress of the United States on March 17, 1882; it is to be regretted that so long an interval was allowed to elapse before its publication. The volume is a large one, three inches in thickness, and containing nearly 1200 pages. Scarcely any of this large quantity of letterpress is without interest and value, and we here give an account of the work described in it.

The Commission began the second decade of its existence in 1881, and the present report shows how greatly the organisation has extended itself, and what large results it has achieved in its first ten years. The central offices of the Commission are at Washington, and up to the year 1881 were confined to the private residence of its public-spirited chief, Mr. Spencer Baird, who devoted the greater part of his house to the State service without remuneration. In 1881 a building was erected next to the Commissioner's residence, at the public expense, to provide space for the increased administrative work. The stations where the varied operations of the Commission are carried on are scattered throughout the United States territory. These operations fall naturally under three heads: (1) Economical statistics and historical data concerning the fishing industries; (2) the applied science of regulating fish supply and distribution; (3) the pure science of marine zoology. The part of the work belonging to the first of these divisions is conducted partly at the central offices, partly at the seats of the industries in question. The two other fields of work are, of course, not always distinctly separate. Since 1878 buildings at Fort Wharf, Gloucester, Mass., had been occupied for hatching operations, but in 1881 they passed into the possession of a private firm, since which time only reports on the fisheries and records of ocean and atmospheric temperatures have been obtained from Gloucester. The principal site of the purely scientific work during the summer season was Wood's Holl, Mass., where the Commission possessed a sea-side laboratory. Researches on the artificial propagation of oysters, &c., were carried on at St. Jerome, Md., near the mouth of the Potomac. Cultivation of the land-locked or Schoodic salmon was practised on the Grand Lake Stream, near Calais, Me. The Penobscot or Atlantic salmon (*Salmo salar*) similarly received attention at Buckport, Me. Another station, where lake trout, brook trout, California trout, &c., were hatched, was at Northville. The principal hatchery for the Californian salmon was on the McCloud River, a branch of the Sacramento. Shad eggs were hatched at Battery Island, Md., at North-East River, Md., near the mouth of the Susquehanna, at the Central Station, Armory Buildings, Washington, at Washington Navy Yard, on the Potomac river-barges, and at Avoca, N.C. Carp ponds were maintained at Monument Lot and at the Arsenal, Washington. The Commission acknowledges valuable assistance received from almost all departments of the Government, but especially from the Navy Office, which, in compliance with decrees of Congress, has detailed steamers fully manned and equipped, lent launches, and executed work and repairs at the navy yards. Steam-

[1] Washington, 1884.

ship and telegraph companies have also aided in the work of the Commission.

Up till 1879 the Commission was not in possession of any vessel of considerable size: its explorations at sea were carried on by means of boats either hired or lent by the navy. In 1879 Congress voted money for the building of a steamer to be entirely devoted to the work of the organisation. This vessel was designed as a floating hatching station capable of being moved from place to place according to the season and the opportunities afforded, but she was not intended to go to sea in all weathers or to any great distance. She was named the *Fish-Hawk*, and was built at Wilmington, Del., from the designs of Chas. W. Copeland, consulting engineer of the Lighthouse Board. A very complete and interesting report is presented in the volume before us on the construction of the *Fish-Hawk* and the work performed by her in 1880; and another on her services in 1881. The *Fish-Hawk* is 156 feet long over all, 27 feet in the beam, and 7 feet 2 inches in draught at the stern. Her ordinary speed is about 9 knots an hour. The hull below the main deck is of iron, sheathed with yellow pine; above the main deck she is of wood. The hatching apparatus and machinery for working it are placed on the main deck immediately abaft the forecastle; the space thus set apart is 47 feet in length. On the after part of the main deck is the principal cabin, which contains the Commissioner's office. Above the main deck, extending from stem to stern, is a promenade deck, on which are the hoisting and reeling engine, the dredging boom, its heel attached to the foremast, and at the after end the naturalists' laboratory. The vessel is rigged as a fore and aft schooner, carrying a fore-staysail, a foresail and mainsail; she has four boats, the largest of which is a steam-cutter.

The *Fish-Hawk* has been found to fulfil admirably the purpose for which she was designed, viz. the economical and effective hatching of shad. But it had long been evident that the Commission required also a sea-going steamer to investigate the conditions and extent of the known, and to discover new, fishing-grounds, to ascertain the complete history of the migrations of food-fishes, to add, if possible, to the list of species available as food, and to study marine phenomena in general. The reward to be expected from this kind of work was indicated by the history of the discovery of the tile-fish, an entirely new species of which some specimens were brought in by a fishing-vessel in 1879. The *Fish-Hawk* made a trip to the place where the tile-fish was found, at the western edge of the Gulf Stream, and found that it was as abundant over a large extent of ground, as the cod is in other places. The area dredged over was found to be also in other respects a valuable fishing-ground, and extremely rich in all forms of life, many new and interesting species being discovered. The tile-fish has been found to be of great value as food when fresh, and to be as easily salted and preserved as the cod. In consideration of these facts Congress voted 103,000 dollars for the building of an ocean steamer for the work of the Commission, to be called the *Albatross*.

In 1881 the Commission began the publication of another annual volume in addition to its Report. It is called the Fish Commission Bulletin, and the first issue contained a memoir on the development of food-fishes, by John A. Ryder; one on the life-history of the eel, by G. Brown Goode; one on the salmon disease in English waters, by Prof. Huxley and S. Walpole; and other papers on fish-hatching and fisheries. Besides this were published in 1881 four census bulletins, and a volume of tables containing statistics of American fisheries, all prepared under the supervision of members of the Commission. In the latter part of the year a monograph on the oyster industry was issued by Mr. Ernest Ingersoll.

The results of the year's work in the three several departments already defined are given in three separate appendices to the Commissioner's report. Those belonging to the first department are contained in Appendix B, which consists of six memoirs, only two of which refer to American fisheries. The first of these is on the history of the mackerel fishery, by Messrs. Brown Goode, Collins, Earll, and Clarke, and occupies nearly a third of the whole volume. It begins with an account of the natural history of the fish, and of its geographical distribution, by Mr. Brown Goode. He finds that the species (*Scomber scombrus*) is confined to the North Atlantic. Its southern limit on the American coast is Cape Hatteras, lat. 35°; its northern limit, the Straits of Belle Isle, lat. 52°, though stragglers may occur further north. Its northern limit on the European coast is North Cape, lat. 71°; its southern, the Mediterranean. The mackerel appears in large shoals on the American coast every summer; as yet it has not been ascertained where it passes the winter. Prof. Hind, who is a Canadian, believes that the fish hibernates in the mud, near shore. Mr. Brown Goode, with much greater probability, argues that the shoals move out to the deep ocean in autumn. He distinguishes between the littoral and bathic migrations of this and other species, and concludes that this fish, like others of similar habits, is influenced in its movements chiefly by temperature, food, and breeding instincts. The mackerel only remains near shore while the temperature of the water is above 40° F. Off Cape Hatteras mackerel first appear about March 20; in the Gulf of St. Lawrence they are not abundant till June. The shoals disappear in October, though occasionally some are caught in December. The mackerel spawn in water of 15 fathoms and less, and while spawning do not take bait, or rise to the surface. The eggs are pelagic, and the young fish grow to 6½ or 7 inches in the first season, probably reaching full size in four years. The mackerel's food consists chiefly of pelagic forms, but not so exclusively as in the case of the herring. A great deal of space is given in this account to the evidence of fishermen as to the food of the mackerel, but as no scientific interpretation is given of their somewhat vague descriptions, the reader does not learn much from the discussion. We conclude that the food consists largely of copepoda, crustacean larvæ, schizopoda, and pteropoda. One paragraph dealing with the food question is, to an English reader, somewhat amusing. The author says that the food of the mackerel is called in England the "mackerel-mint," and consists of "sand-lants [*sic*] and five other species of fish." We are not sure, but we think "mackerel-mint" is a mistake for "mackerel-midge," which is the young of various species of rockling, but especially of *Motella tricirrata*. In the same paragraph it is said that mackerel have been seen to devour the swimming larvæ of tape-worms. The first chapter of the essay can only be regarded as a preliminary inquiry to serve as a basis for accurate investigation. It seems strange that Prof. Brown Goode and Mr. Baird should mention a mysterious membrane over the eye of the mackerel without giving the anatomical meaning of the membrane; and it is equally unsatisfactory to read an account of the dissection of a mackerel, quoted from Bernard Gilpin, in which the air-bladder and the aorta are mixed up. Next follows a history of the mackerel-fishery in the United States, from which we learn that since 1880 the purse-seine has come into general use for mackerel-catching. The mackerel fleet consists of 468 vessels, mostly of 60 to 80 tons, schooner rigged, and very fast sailers. The old method of hook-fishing is described fully in a historical chapter. Besides the purse-seine, gill-nets are also used in mackerel fishing at the end of the season, off the New England coast. The total catch of mackerel in 1881 off the United States coast is estimated at 294,667,000 fish.

Chapter III. of the essay contains an account of the legislation affecting the mackerel fishery. Even at the time of printing the Report in 1881, on account of the

clamours of the inshore fishermen against the purse-seine, a Committee of Senate was appointed, which was likely to result in additional regulative enactments. The rest of the essay contains an account of mackerel-canning, statistics of the fishery in 1880, the inspection laws, a chronology of the history of the fishing, a list of vessels engaged in the industry, and a table of the catch by American vessels in Canadian waters.

A paper by Mr. Harrison Wright relates the history of the shad fishery in the Vale of Wyoming, on the north branch of the Susquehanna. The Indians caught shad there before white settlers came, about 100 years ago. The white people used shad seines with great success until 1830, when the construction of dams for a canal put an end to the fishery altogether. There were about forty permanent fisheries, some of which had an annual catch of 10,000 fish, weighing three to nine pounds each. It is suggested that the fishery might be restored by the construction of ladder-ways over the dams, and other improvements, together with a restocking of the river with young shad.

A translation is given of a report on the Loffoden fishery in 1880 by Lieut. Niels Juel, the chief of the police administration, which has charge of public order, &c., at the fishery. This report is very interesting, but we have scarcely space to summarise it: we can only give a few of the prominent facts. The number of boats engaged varied from 1000 to 5000; the total number of fishermen was about 27,000, of whom about 13,000 fished with gill-nets, 10,000 with long lines, and 3000 with hand-lines. The author believes that the water-temperature most suitable for cod is between $3\frac{1}{2}°$ C. and $4\frac{1}{2}°$ C. The total yield of the fishery in 1879 was 25,000,000 fish, valued at 5,000,000 crowns. In 1880 the yield was still greater, being only surpassed by that of 1877.

Another paper in this appendix gives extracts from the official statistics of the Norwegian fisheries in general, and another is a transcript, from the London *Quarterly Review*, of an article on "The Fish-Supply of London." In the latter the opinion of very high authorities is quoted that the fisheries of the North Sea, small as its area is, are practically inexhaustible, and that trawling does not tend to exterminate any species of food-fish.

Appendix D deals with the propagation of food-fishes. It contains twelve papers, which are, with one exception, reports on the work of the various stations of the Commission during the year. The exception is a paper on the "Repopulation of the Water-Courses of Belgium," by Baron de Selys Longchamps. This essay shows how the waters of the Meuse and Scheldt have been rendered barren by the construction of dams and the pollution from factories; and that it will be a matter of great difficulty to remedy this state of things by the construction of fish-ways and the purification of the rivers.

The whole work of the Commission, from its institution in 1871 to 1880, is reviewed in a number of statistical tables prepared by Chas. W. Smiley. In the period in question 43,000,000 shad were artificially hatched and released on the spot, 53,000,000 successfully transported; 15,000,000 of Californian salmon have been hatched and released on the Pacific coast, 31,000,000 transported to other States, and 4,000,000 sent abroad. Of the 31,000,000 transported, about 50 per cent. were successfully introduced into distant waters. In 1879 and 1880 61,000 carp were distributed.

Then follow seven reports on the work of the various hatching-stations, in which occur, here and there, interesting accounts of experiments and inventions connected with the hatching apparatus. At Wood's Holl experiments were made with a view to arranging an apparatus suitable for hatching cods' eggs; the experiments were only partially successful. It was at Wood's Holl that Prof. Ryder carried on his researches into the embryology of the cod. Experiments on the artificial hatching of the Spanish mackerel were made at Cherrystone, Va.

Lastly, we have to notice Appendix C, on Natural History and Biological Research. First, we have an account of the Annelida Chætopoda collected on the Massachusetts coast by the summer expedition of Union College. Three genera and sixteen species are described here as new to science. Of these Thaumastoma is said not to belong apparently to any known family. As far as we can judge from the figure of the head given, the genus is allied to the Nereidæ; but all the figures in the plates to this paper are rough and unsatisfactory.

Mr. Coutance records some experiments on the effect of saline solutions of the same strength as sea-water, but of different composition, on marine molluscs. In all cases the solutions were ultimately fatal; but it would be interesting to have these experiments repeated with some alterations: viz. the solution to be substituted for the sea-water gradually, instead of suddenly, and the natural conditions to be more nearly realised in all other respects save the composition of the medium.

Prof. J. A. Ryder contributes a paper on "The Importance of the Protozoa and Protophytes as the Primary Source of the Food of Fishes." He might have said simply Protophytes, since Protozoa are fed by these; and it is obvious, since a small proportion only of marine animals feed on littoral algæ, that marine life depends largely on pelagic Protophyta. The author reviews the evidence that most Entomostraca feed on Protozoa, and that these feed on diatoms, &c., while the Entomostraca constitute the food of vast numbers of fish. He gives evidence to show that the adult shad feeds while spawning, in fresh water, and that the newly hatched shad feed on exceedingly small and young Entomostraca. The paper is rather a popular essay than an original memoir.

S. A. Forbes finds that the earliest food of the young of *Coregonus albus* in Lake Michigan consists almost entirely of Copepoda of the species *Cyclops Thomasi* and *Diatomus sicilis*.

Prof. Ryder, in another paper, describes some successful experiments in retarding the development of shad ova. It was found impossible to develop them at 38° F. or at 45° F. Ova kept moist on flannel trays at 52° F. were killed by fungus, but the development proceeded at the rate of nine days for the embryonic period. In an experiment in which glass McDonald jars were used with water from the Potomac when the river was at the temperature of 51° F. to 57° F., development took place normally, and hatching was retarded till the thirteenth to the sixteenth day. The embryos were lost by accident, but the author thinks it would require about twenty-five days at this temperature to absorb the yolk, and thus, if the same success could be insured on board ship, there would be ample time to transport embryos to Europe.

Prof. Ryder's remarks at the end of this paper, on "The Rationale of Retardation" somewhat neutralise the satisfaction experienced in reading the account of his practical work. In the present state of science it is scarcely allowable to talk of the nucleus as a "directive dynamic centre," because the phrase has little definite meaning. It is not true that the division of a nucleus has been described by Flemming under the terms "systole" and "diastole"; that author's use of those words referred to certain alternating movements in a nucleus previous to its division. The division of the nucleus does not give us a complete explanation of the phenomena of retardation. It is a truism that retardation of development means diminution in the rapidity of the rate at which cell-divisions take place; but to talk of the *vis essentialis* of segmentation residing in the nucleus is about as instructive as an attempt to localise the horologity of a clock, the *vis essentialis* of a steam-engine, or the situponability of a chair.

The Report for the year 1882 was published at the end of last year, only a few months after the issue of the volume for 1881. In some respects this, the most recent annual Report, is the most interesting of the whole series,

the year 1882 having been unusually eventful for the Commission. During that year the new ocean steamer *Albatross* was constructed, steps were taken towards founding a permanent station at Wood's Holl, the Armory Building at Washington was fitted up as the central station of the Commission, and the surprising fact came to light that the tile-fish, investigated a short time previously by the Commission, had been practically exterminated by unknown natural causes. Besides the history of these events the Report contains a long and elaborate memoir, by John A. Ryder, on "The Development of the Cod," which forms one of the most conspicuous features of the volume, and some interesting papers on the artificial propagation of the oyster: the rest of the volume is chiefly made up by the usual separate Reports of the various hatching-stations, and papers on American fishing industries.

The appropriation made by Congress for the *Albatross* in 1881 was too small, and it was not till March, 1882, that an additional grant was obtained, and the contract for her construction was signed. On November 11 the vessel was put into commission with Lieut. Z. L. Tanner, formerly commander of the *Fish Hawk*, as captain. On December 30 the *Albatross* left Wilmington, where she was built, for Washington, on a trial trip. Her total displacement is 1000 tons. A description of the vessel and of her equipment is promised in a subsequent Report. The arrangements for establishing the principal permanent seaside station of the Commission at Wood's Holl made some progress during the year, but were not completed. An agreement was made upon the conditions of the purchase of the requisite land, and all the necessary technical formalities arranged; but it was essential that there should be constructed within the great harbour of Wood's Holl an inner harbour, which would serve for a harbour of refuge as well as for the purposes of the Commission. An appropriation of 52,000*l*. for the new harbour was granted by Congress, but the President decided to defer action upon this and other new items in the harbour bill, and, consequently, the establishing of the Station was delayed for a time. Nevertheless, Wood's Holl was made the head-quarters of the general summer work of the Commission, and a large party were engaged there during July and August working at marine zoology and exploration. The *Fish Hawk* was stationed there during this time.

The central station at Washington was fitted up with shad-hatching apparatus, and was used as the centre from which all young shad hatched on the rivers Potomac and Susquehanna were distributed: the extreme limit of distribution was the Colorado river in Texas. The number of shad fry distributed was over 20,000,000.

The curious history of the tile-fish (*Lopholatilus chamæleonticeps*), into the distribution of which researches were made in 1881, is related in a report by Capt. Collins in Appendix B. At the beginning of Capt. Collins's paper an account of the fish itself is given, from which we learn that it belongs to the family Latilidæ, Gill, the representatives of which are mostly inhabitants of tropical seas and of shallow water. The ground where the tile-fish had been found lies between the latitudes of Hatteras and Nantucket, in long. 70° to 71°, about 100 miles off shore, at a depth of 90 to 125 fathoms. In March and April, 1882, vessels arriving at the principal Atlantic sea-ports reported the extraordinary occurrence of vast numbers of large dead and dying fish floating on the surface of the sea over the region where the tile-fish had been found. It was ascertained that a large proportion of these dead fish were tile-fish. In order to determine the extent of the destruction, a steamer was chartered by the Fish Commission, and sent out to the tile-fish ground in September. Not a single Lopholatilus could be obtained, but a new fish belonging to the genus Setarches was discovered, which promised to be of importance as a food-fish. An account of this exploring cruise was published in the Fish Commission *Bulletin* for 1882.

Prof. Ryder's memoir on the development of the cod is founded on researches made at Wood's Holl, Mass., in June, 1881, and at Fulton Market, New York, in February, 1882. On the former occasion an apparatus devised by Marshall MacDonald was used, and about 5000 young fry were set free at Wood's Holl, and 25,000 sent to Chesapeake Bay and liberated there; these were all the fry obtained from several millions of eggs artificially fertilised. The memoir is a long one, extending to more than 100 pages, and is illustrated by twelve plates of woodcuts. This is the first publication in which the development of the cod has been described in detail and figured; the description given by Sars in his report to the Norwegian Government some years ago having been rather general, and not illustrated. The facts are given in Prof. Ryder's paper for the most part with great accuracy and fidelity, although the appearance of the woodcuts is not very pleasing, and the more complicated of the figures are a little wanting in clearness. The theoretical part of the paper will not commend itself to those who have accepted the generalisations of embryology at present prevalent. For example, it is stated that in Teleosteans, at an early stage, the body-cavity and segmentation-cavity are continuous; but the evidence produced in support of this revolutionary proposition is not by any means conclusive. It cannot be said that the obscurities of Teleostean embryology, such as the invagination of the gastrula, or the development of the genital ducts, are much illuminated by Prof. Ryder's memoir: on the latter point no information is given.

Two other interesting papers are included in the Appendix for Natural History and Biological Research: one by Sidney J. Smith on the Decapod Crustacea from the dredgings of the *Albatross* in 1883, and the other by Prof. Verrill on the fauna of the tile-fish ground at the western edge of the Gulf Stream. The former of these is an extremely elaborate memoir, accompanied by ten plates of clear and well-executed woodcuts, illustrating species and structures which had not before been sufficiently figured. The paper contains a great number of new species and several new genera: each new species is described with wonderful minuteness, and, a long table of measurements being added to each description, no one having occasion to use this memoir will be able to complain of inexactness or incompleteness in the characterisation of specific distinctions.

The paper of Prof. Verrill is short, being simply intended to indicate the most interesting features of the peculiar area investigated. It was found in the operations of 1882 that the invertebrate fauna, discovered to be so unusually abundant in 1881, had, like the tile-fish, suffered great destruction in the interval between the two seasons. This was especially the case among the Crustacea, some species, which had been taken in thousands at a single haul, having become extremely scarce. Prof. Verrill believes the remarkable destruction of life had been caused by a very severe storm which occurred in the spring of 1882, and which probably forced out the cold coast water over the Gulf Stream slope.

The whole of Appendix D has reference to oyster culture. It contains six memoirs, two of which describe experiments on the artificial propagation of the American oyster, *Ostrea virginica*. Lieut. Francis Winslow studied the subject at Beaufort, N.C., and at Fair Haven, Con.; Prof. Ryder at St. James's Creek, Md. In both cases, though a fair amount of success was obtained in impregnating the ova and keeping the embryos alive in the free-swimming stage, no satisfactory method was discovered of obtaining a supply of attached spat with any certainty. Prof. Ryder and Col. MacDonald on one or two occasions found that their embryos had fixed themselves to the sides

of their aquaria in large numbers, but they could not keep them alive more than a day or two after the attachment had taken place.

The growing extent of the piscicultural operations of the Commission, as indicated by the Reports in Appendix E, is marvellous. Statistics of the distribution of shad-fry during 1882 are given in a paper by Chas. W. Smiley; the total number distributed was over 30 millions. The total number of carp distributed was 259,000, of Penebscot salmon 1,716,000, of Schoodic salmon 1,482,000.

It would be extremely interesting to have some information as to the result of all this work, as to the effect produced on the supply of fish in the rivers, and on the productiveness of the fisheries. The Commissioner points out that it is of little use to put anadromous fish into rivers if the waters are obstructed by dams or made uninhabitable by pollution, and a new fish-way to remedy the former difficulty is described by Col. M. MacDonald in Appendix A. But all who are acquainted with the labours of the American Commission would be grateful if Mr. Chas. Smiley would apply his great power of handling statistics to exhibiting the economical results of the piscicultural work.

J. T. CUNNINGHAM

NOTES

THE statue of Darwin will be unveiled in the great hall of the Natural History Museum, Cromwell Road, on Tuesday, June 9, at 12 o'clock, when Prof. Huxley, President of the Royal Society, on behalf of the memorial committee, will formally transfer it to the care of the Masters of the Museum, who will be represented by His Royal Highness the Prince of Wales. Places will be reserved for the committee and subscribers to the memorial, but the greater part of the hall will be open to the public during the ceremony. The statue, which has been executed by Mr. Boehm, R.A., is of marble, and seated, rather larger than life-size; it is pronounced by those who have seen it to be an admirable likeness as well as a fine work of art.

IT is now twenty-one years since the *Geological Magazine* was first issued. During all that time Dr. H. Woodward, F.R.S., has been an editor, and for almost the whole of it the principal editor, on whom the main burden and chief responsibility of the work has fallen. It has been a work which has not only cost him much time and labour but also has been practically unremunerative. His friends among geologists accordingly purpose to celebrate the "majority" of the *Magazine* by presenting to him a testimonial in appreciation of his services to science. A meeting was held last week, at which an influential committee was formed, a list of which will shortly be circulated. The treasurer and secretary is Dr. Hinde, F.G.S.

WE greatly regret to record the death of the Rev. Thomas W. Webb, Vicar of Hardwick, near Hay, Brecon, well-known for his writings on astronomical subjects. We hope next week to refer to the work he has done in astronomy.

THE death is announced of Mr. Peter William Barlow, F.R.S., the well-known engineer.

A CONGRESS on hydrology and climatology will, it is stated, be held at Biarritz during October next. The French Government has brought the matter to the notice of foreign Governments, in order that the latter may take the necessary steps to be represented at the congress.

ON April 13 the Leander McCormick Observatory attached to the University of Virginia was opened by public ceremony. The buildings are situated on a hill called "Observatory Mountain," because in 1825 Thomas Jefferson erected a small observatory there, which gradually fell into decay. They consist of residences for the director and assistant, offices, a small observatory for minor observations, and a large building for the dome. The observatory proper consists of a cylindrical building surmounted by a hemispherical dome forty-five feet in diameter, and a rectangular building used as a library and computing office. The walls are of brick, the circular portion being heavily buttressed, and bearing at the top a coping of Ohio stone. On this rests cast-iron rails, on which the dome revolves. The latter weighs 25,000 lbs., and is composed of a framework of steel covered with galvanised iron and lined with painted canvas, having three openings covered by shutters when not in use. It takes five seconds to open one of these, and a minute and a quarter to revolve the dome quite round. The telescope, which is mounted on a brick pier under the centre of the dome, is similar at the Washington Observatory. The clear aperture of the object-glass is twenty-six inches. Like so many other important scientific and educational institutions in the United States, this observatory is due to the generosity of a wealthy native of the State, Mr. Leander McCormick, from whom it takes its name. This gentleman presented both telescope and building to the University. The cost is stated to have been about 13,000*l.*, the telescope costing over 9000*l.* The directorship of the observatory, to which post Mr. Ormond Stone, director of the Cincinnati Observatory, has been elected, is endowed with a sum of 10,000*l.*, collected by public subscription; while Mr. W. H. Vanderbilt has given the University a further sum of 5000*l.* as an endowment to pay the salary of an assistant observer, the expenses of publication, &c. According to the founder's plan the observatory is not to be confined to purposes of the University alone, but for general scientific research, so that students from any part of the United States who desire to become professional astronomers may receive a thorough training there. In accordance with this plan the Professorship of Astronomy in the University is a wholly distinct post from that of Director of the Observatory. Prof. A. Hall, of the National Observatory at Washington, delivered the opening address, taking for his theme "The Instruments and Work of Astronomy."

FROM various publications which we have recently received from the Government of Hong Kong Dr. Doberck, the astronomer, appears to have lost no time in employing the new observatory. The last batch of observatory papers include observations on lunar transits across the meridian of Hong Kong, and on the height of Victoria Peak. As this eminence is the most important in the east (with the possible exception of Fujiyama) in one sense—the sense in which Richmond Hill is more interesting than Mount Everest—it may be added that the mean height of the peak is 1710·6 feet above the Observatory, or 1818 feet above the mean sea-level. There is also a report on five-day means of the principal meteorological elements for 1884, constructed according to the recommendations of the International Meteorological Congress, and a complete weather report for the same year. With four well-equipped observatories (Tokio, Shanghai, Hong Kong, and Manila) at work, the meteorolgy of the China Seas will soon cease from being the sealed book which it practically is at present.

LAST year was a tolerably productive one for the collectors of prehistoric remains in Switzerland. The water of the lakes was almost constantly below the highest level, which is the most favourable state of things for explorations around the lake-dwellings. The remains discovered belong mostly to the Bronze period, and the chief localities in which they were found were Lake Neuchâtel and the settlement of Wallishofen near Zürich, the latter of which is the only station of the Bronze period yet know in Eastern Switzerland. Among the most remarkable articles discovered at this settlement in 1884 were a splendidly preserved bronze sword, several dozens of bronze hatchets, bracelets, &c. Of the remains of the Stone period discovered in

the same year the most notable are those obtained at Robenhausen, including several pretty knife-handles made of yew, some excellent specimens of mechanical industry, such as thread, woven fabrics, fishing-nets, &c., and ears of barley and wheat, one being a specimen of the rare *Triticum turgidum*.

THE Zoological Society of Philadelphia, according to the Thirteenth Report of the Board of Directors, appears to have suffered during the past year, like many other institutions dependent on the public for support, from the general depression of trade. The financial balance shows a large reduction; nevertheless the Superintendent is able to report that the collection "presents to-day a greater and more typical variety of animal forms, in furtherance of the educational facilities which have been one of the chief aims of the Society, than at any previous period of the history of the garden." Among the principal additions during the year was a hippopotamus, the first obtained by the Society, a collection of European water-fowl, and a brush-turkey (*Tallegalla lathami*) of New South Wales. The specimen procured is a female, but it is hoped that a male may also be obtained, and that its extraordinary habit of hatching its eggs, by covering them with decomposing vegetable matter, may be shown in the garden.

IT seems that the experiments of Dr. Ferran in inoculation for cholera have been stopped by the Spanish Government.

THE Sanitary Congress at Rome has been engaged during the past week mainly in discussing quarantine regulations.

WE have received Prof. Theodore Gill's "Account of the Progress in Zoology" for 1883, from the Smithsonian Report—a substantial pamphlet of over fifty pages. The special discoveries recorded have been selected either on account of the modifications which the forms considered force on the system, or because they are or have been deemed of high taxonomic importance, or the animals *per se* are of general interest; or, finally, they are of special interest to the American naturalist. The arrangement of the account is as follows:—General Zoology, Protozoans, Porifers, Cœlenterates, Echinoderms, Worms, Arthropoids, Molluscoids, Mollusks and Vertebrates. Each of these divisions is sub-divided according to the discoveries to be noted. At the end, a brief bibliography of noteworthy memoirs and works relating to different classes is appended. "The statement," Prof. Gill says, "is not intended for the advanced scientific student so much as for those who entertain a general interest in zoology, or in some of the better-known classes. It is compiled for the many rather than the few, and hence, perhaps, zoologists cultivating limited fields of research may find omissions, as well as notices of discoveries of minor importance."

ON May 20 a terrific storm raged in Paris; a stupendous peal of thunder was heard at 11 a.m. It seems the lightning struck the top of a high furnace at St. Ouens, near Montmartre. It is supposed that it was attracted by a mass of lead which was placed at this elevated situation for some purpose. The peculiarity is that no trace of the lead was afterwards found.

THE centennial celebration of Blanchard and Jeffries crossing the Channel in a balloon was celebrated on Sunday at Guine, Pas de Calais, where the two travellers landed.

SHOCKS of earthquake were felt at Wartberg and Kindberg, Austria, on May 20 towards 1.30 a.m. A sharp shock was felt at Smyrna at 7.15 p.m. on May 26.

PROF. DEWAR, F.R.S., will give a discourse on "Liquid Air and the Zero of Absolute Temperature" at the last Friday evening meeting of the season on June 5, at the Royal Institution.

A FEW years since the German Anthropological Society initiated an exhaustive investigation among German school children as to the proportion of those with dark and with fair complexions. This has been followed by similar investigations in Belgium, Switzerland, and Cislethian Austria, and these have supplied gaps in the German inquiry. The result was, according to *Die Natur*, laid before a recent meeting of the Berlin Academy of Sciences by Herr Virchow. In all, 10,077,635 children were examined as to the colour of the skin, hair, and eyes; 6,758,827 in Germany, 608,678 in Belgium, 505,609 in Switzerland, and 2,304,501 in Austria. The geographical boundaries were the Pregel and Dniester on the east to the Vosges on the west; the Baltic and German Ocean on the north, to the Adriatic and the Alps on the south. The following is the result:—Of pure blondes there were found in Germany 2,149,027; in Austria, 456,260; in Switzerland, 44,865; a total of 2,650,152, which, on a total of 9,468,557 (Belgium being omitted here) children examined, is rather more than one-fourth. The number of brunettes was: in Germany, 949,822; Austria, 534,091; in Belgium, 167,401; in Switzerland, 104,410; a total of 1,755,724, or about one-sixth of a total of 10,077,635. Hence more than half the school children of Central Europe are of the mixed type. The distribution of the pure types is very different. In Germany 31·80 per cent. is fair and 14·05 per cent. dark; in Austria the dark predominate, being 23·17 per cent., while the fair amount only to 19·79; in Switzerland the disparity is still greater, for the blondes are only 11·10 per cent., while the brunettes are 25·7; and in Belgium the blondes are 27·50 per cent. In Germany, therefore, the fair complexions predominate; but even here the proportions vary greatly, getting less and less as we go towards the south. In North Germany the proportion is between 43·35 and 33·5 per cent.; in Central Germany, about 25·29; and in the south, only 18·44; while, on the contrary, the proportion of dark children diminishes from 25 per cent. in South Germany, to 7 per cent. in the north. This appears to show the incorrectness of the theory of the French anthropologist that we must seek the real Germans in South Germany, and that North Germans are a dark race, a mixture of Finns and Slavs. The fair people are most numerous in Sleswick-Holstein, Oldenburg, Pomerania, Mecklenburg, Brunswick, and Hanover. That this should be the case in Mecklenburg—formerly a Slav district—is due, according to Herr Virchow, to a return-emigration of the Germans. Middle and Western Germany were especially the cradle of this emigration. Flemings, Dutch, and Frisians thus reached Holstein, Westphalia, Brunswick, Mecklenburg, and Pomerania. Saxony, Silesia, and Northern Bohemia were colonised through Eastern Franconia, Austria from Bavaria. The emigration of the German tribes took place at two different periods: the first, a movement from south to west, which ended with the foundation of the Frankish monarchy; the other a return to the last, which began with the Karolingian period, and is not yet concluded. The latter has led to a permanent colonisation, and to the formation of a new pure German people. The deep brown colour of the south and middle Germans, as well as of the Swiss, is traced by Herr Virchow to the Romans, Rhetians, and Illyrians, and especially to the remnants of the Celtic or pre-Celtic inhabitants, which have now become mixed with the Germans.

THE experiment of acclimatising the American Whitefish (*Coregonus albus*), lately tried by the National Fish Culture Association, has met with great success. Until now the attempts made were unsatisfactory, the utmost difficulty being experienced in finding suitable lakes for the reception of this valuable edible fish. The whitefish in question were incubated at South Kensington in March, and afterwards transferred to ponds at Delaford where they have thrived well ever since.

THE Naturalists' Societies in the East of Scotland have advanced an important stage. They have been established, have worked, and now have formed a union, the first report of which we have now before us. The union embraces the societies in the counties of Aberdeen, Fife, Forfar, Kincardine, Kinross, and Perth, and now consists of ten societies. The president, Dr. Buchanan White, of Perth, explained in his inaugural address the functions of the union as distinguished from those of the individual societies. Its main object of course is to carry on more effectually the work for which each of the societies that compose it has been formed, that work being the promotion of the study of natural science, especially of local natural science. Rivalry begotten of communication and connection, he argues, is as valuable to societies as to individuals; and while each society was isolated and worked independently in its own district, the sum total of the work done was necessarily imperfect because of want of uniformity in the matter of details; one subject has been thoroughly worked while another has been untouched, certain districts have been investigated, while others have been neglected, and the relations of one district to another have not been considered. Each society has toiled in a quarry in its own district, and has brought forth good stones, but they lie in an unsorted heap. The union undertakes the task of sorting and utilising them. On this broad principle the union started, and the president laid down in the opening address the programme of its work for the immediate future. The first step was to ascertain the present state of knowledge of the zoology, botany, geology, and meteorology of the six counties included in the union. For this purpose a uniform method of treatment was adopted. Each reporter in his own special subject states how far the subject has been investigated, what parts of it especially require investigation, both as regards the district and the subject, what the probable richness of the district is, what important works, if any, have been published on the subject and district, and, finally, what work should be taken in hand at once. These statements make up the bulk of this first report, and there are in all nineteen, covering almost every department of natural history. The union, it thus appears, directs and organises the work of its affiliated societies, and prevents waste of power.

THE additions to the Zoological Society's Gardens during the past week include a White-bellied Beaver-Rat (*Hydromys leucogaster*), a White-bellied Sea Eagle (*Haliaetus leucogaster*), two Stump-tailed Lizards (*Trachydosaurus rugosus*), a Great Cyclodus (*Cyclodus gigas*), a Diamond Snake (*Morelia spilotes*) from Australia, presented by Mr. E. P. Ramsay, C.M.Z.S.; an Australian Cassowary (*Casuarius australis*) from Australia, presented by Mr. T. H. Bowyer Bower; four Pucheran's Guinea Fowls (*Numida pucherani*) from East Africa, presented by Commander C. E. Gissing, R.N.; a Kestrel (*Tinnunculus alaudarius*), British, presented by Mr. C. A. Marriott; seven Striped Snakes (*Tropidonotus sirtalis*) from North America, presented by Mrs. A. H. Jamrach; a Common Viper (*Vipera berus*), from Epping Forest, presented by Mr. F. W. Elliott; two Lions (*Felis leo*) from Africa, two Pumas (*Felis concolor*) from South America, deposited; a Collared Fruit Bat (*Cynonycteris collaris*), four Upland Geese (*Bernicla magellanica*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

DOUBLE-STAR MEASURES.—Nos. 2662–63 of the *Astronomische Nachrichten* contain the first division of a series of measures of double stars made by Herr R. Engelmann during the years 1882–84, preceded by a comparison of the differences between the observer's positions and distances of a number of stars, with those measured by Dembowski and Asaph Hall, and other particulars bearing upon his own results. For several of the more interesting binaries, the following epochs are given:—

				°		″
Castor	...	1882·88	...	234·3	...	5·56
ζ Cancri	...	1884·28	...	67·0	...	0·94
ω Leonis	...	1884·23	...	91·4	...	0·66
ξ Ursæ Majoris		1884·41	...	249·6	...	1·92
γ Virginis	...	1883·07	...	155·6	...	5·22
42 Comæ Beren.		1882·93	...	192·1	...	0·56
ξ Bootis	...	1884·45	...	266·6	...	3·65

MINIMA OF ALGOL.—The following Greenwich mean times of geocentric minima of Algol have been obtained after applying a small correction to the period given by Prof. Schönfeld in his second catalogue of variable stars, so as to satisfy more nearly the observations of the late Prof. Schmidt in 1882 and 1883:—

		h. m.				h. m.				h. m.
July	25	13 10	...	Sept.	3	16 29	...	Sept.	29	11 46
	28	9 58	...		6	13 17	...	Oct.	2	8 34
Aug.	14	14 49	...		9	10 6	...		19	13 26
	17	11 38	...		12	6 54	...		22	10 15
	20	8 26	...		26	14 57	...		25	7 3

CENTRAL SOLAR ECLIPSES IN NEW ZEALAND.—It is well known to those who are interested in astronomical matters that the track of the central line in the total eclipse of the sun on September 9 next is almost entirely over the Southern Ocean, and that the total phase will only be observable on land on the shores of Cook's Straits, New Zealand. It would appear that no central eclipse has traversed those islands during the present century; an examination of the various ephemerides points to the annular eclipse of December 29, 1796, as the last which was there central. An annular, though nearly total, eclipse will take place near the north extremity of the North Island on January 3, 1927, while, on May 30, 1965, when the sun is barely risen to an altitude of 5°, he will be totally eclipsed on the east coast of the North Island, near its north extremity for about 2m. 20s.

It is true that in an old catalogue of eclipses which has been transcribed into several of our popular astronomical treatises those of December 12, 1890, and September 29, 1894, are mentioned as being central in New Zealand, but an examination of these eclipses upon more recent data shows that neither will reach that country. In the eclipse of 1890 the central line ends in about longitude 143° W., latitude 36½° S., totality with the sun on the meridian taking place in longitude 129½° E., latitude 54° south, and the line thus running south of New Zealand. In the eclipse of 1894 it ends not far from longitude 163° E., latitude 56° S.

THE DAYLIGHT-OCCULTATION OF ALDEBARAN ON MAY 22, 1868.—Mr. H. Sadler reminds us that the occultation of Aldebaran to which reference was lately made in this column, as having been pointed out by Mr. Newall in 1868, when the star was only some eight degrees from the sun's place, was observed by Prof. Asaph Hall. The observation is to be found in the "Washington Astronomical and Meteorological Observations" for 1868, p. 327.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, MAY 31 TO JUNE 6

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 31

Sun rises, 3h. 51m.; souths, 11h. 57m. 25·7s.; sets, 20h. 4m.; decl. on meridian, 21° 59′ N.: Sidereal Time at Sunset, 12h. 42m.

Moon (at Last Quarter June 6, 0h.) rises, 21h. 16m.*; souths, 1h. 43m.; sets, 6h. 10m.; decl. on meridian, 18° 21′ S.

Planet		Rises		Souths		Sets		Decl. on meridian
		h. m.		h. m.		h. m.		° ′
Mercury	...	3 7	...	10 22	...	17 38	...	13 43 N.
Venus	...	4 14	...	12 28	...	20 42	...	23 8 N.
Mars	...	2 50	...	10 21	...	17 52	...	16 31 N.
Jupiter	...	10 13	...	17 25	...	0 37*	...	13 10 N.
Saturn	...	4 54	...	13 3	...	21 12	...	22 24 N.

* Indicates that the rising is that of the preceding and the setting that of the following day.

Phenomena of Jupiter's Satellites

June		h. m.		June		h. m.	
2	...	22 50	II. tr. ing.	5	...	22 43	I. occ. disap.
4	...	23 14	II. ecl. reap.	6	...	22 22	I. tr. egr.

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

CHEMICAL NOTES

IN a paper communicated by Prof. Mendeléeff to the last issue of the *Journal* of the Russian Chemical Society, being a reply to M. Avenarius, the Professor makes a very interesting comparison between his own formula of dilatation of liquids and the logarithmic formula of Waterston, supported in Russia by his opponent, M. Avenarius. He shows by analysis why both formulas express with sufficient approximation the expansion of ether within the limits of 0° and 104°, the observations beyond that limit having to be left aside until we have a more accurate knowledge of the laws of expansion of this substance at higher temperatures and under higher pressures. He demonstrates, moreover, that the logarithmic formula is as inapplicable to water as his own; and, developing both formulas into series, he shows why his own simpler formula ought to be considered as a first approximation to the law of dilatation of liquids until the true law is discovered. Though polemic in its first part, the paper is a masterly piece of scientific treatment of the controversy about so important a question.

FOLLOWING on the lines laid down by Mr. H. B. Dixon in his experiments on the combustion of carbonic oxide in dry and in moist oxygen, Mr. H. Brereton Baker has recently described some very interesting results regarding the combustion of phosphorus and carbon in oxygen. When the elements in question were heated in oxygen which had been kept in contact with phosphorus pentoxide for some weeks, combustion occurred only to a very limited extent. The presence of a small quantity of water-vapour seems to be needed in order to start the combustion (*C. S. Journal*, *Trans.*, 1885, 349).

THE influence of the relative masses of the reacting bodies on chemical changes has of late years received a good deal of attention. Urech has discussed the well-established data regarding the influence of dilution, and of the presence of excess of one or other ingredient, on chemical reactions (*Ber.*, xviii. 94). He points out that the diluent may act both physically and chemically. When it acts altogether as a diluent it does not, according to Urech, affect the rate of the chemical operation. Excess of either reacting body appears always to exert an influence on the rate of change. The causes of the variations in the rate of chemical change are probably very complicated; even the shape and character of the containing vessel may exert an appreciable effect.

EXPERIMENTS are described by M. J. Thoulet (*Compt. Rend.*, xcix. 1072) on the effect of immersing various solid bodies in saline solutions, *e.g.* marble, quartz, &c., in aqueous solutions of sodium or barium chloride. In each case a portion of the dissolved salt was precipitated on the surface of the immersed solid. The conclusion is drawn that there is an attraction between the dissolved salt and the solid immersed, and that the amount of attraction is proportional to the surface of the solid.

SOME time ago Mr. Bayley showed that when drops of various solutions are allowed to fall on to filter-paper, the salt which was in solution in many cases remains in the centre, and a water-ring extends around it. Mr. J. U. Lloyd has extended these observations (*Chem. News*, li. 51). He has observed the distances to which various substances in aqueous solutions extend on pieces of blotting paper, dipped into the solutions, before they are left behind by the water. Great differences were noticed in the length to which different salts thus travelled. Mixtures of salts were also examined; in some cases one salt passes on, leaving the other completely behind. Thus a solution of quinine and berberine sulphates was separated by the method described; the former salt passed on through the paper after the progress of the latter had quite ceased. Dilute sulphuric acid behaved similarly; pure water alone passed onwards. In the case of simple salts dissolved in water, the rule appears to be that the more dilute the solution, the quicker is the separation into salt and water.

CHEMISTS are beginning to realise that the structural formulæ they have so long regarded as final expressions are, after all, very imperfect representations of chemical operations. The molecule of a compound has been treated as a structure built up of atoms; in their anxiety to learn the relations of these atoms chemists have almost forgotten that the molecule is itself a whole. Attention has of late been recalled to this aspect of molecular formulæ. Hartley's researches on "the relation between the molecular structure of carbon compounds and their absorption spectra" have led to results of much interest in this direction. In a paper communicated to the Chemical Society on May 7, Hartley brought forward a series of facts which lead to the conclusion that "molecules vibrate as wholes or units, and the fundamental vibrations give rise to secondary vibrations which stand in no obvious relation to the chemical constituents of the molecule, whether these be atoms or smaller molecules. Hence it appears that a molecule is a distinct and individual particle which cannot be truly represented by our usual chemical formulæ, since those only symbolise certain chemical reactions and physical properties, and fail to express any relations between physical and chemical properties."

NASINI (*Atti d. Acc. d. Lincei Rdct.*, 1885, 74) has been pursuing his inquiries regarding the "atomic refraction" of sulphur in various compounds, and has obtained results which lead him to conclude that the variations in the refraction-equivalents of sulphur compounds cannot be explained by the ordinary structural formulæ employed in chemistry. These variations appear to be connected neither with the valency of the sulphur-atom in the different molecules, nor with the nature of the other atoms which are associated with the atoms of sulphur. Changes in the structure of sulphur-containing molecules seem to be accompanied by changes in the refraction-equivalents of these molecules, but these changes cannot be regarded as due to variations in the valency, or arrangement, of the atom of sulphur they must rather be attributed to some cause which affects the molecule as a whole.

WE notice a very interesting and important discussion raised in the *Journal* of the Russian Chemical Society (vol. xvii. 3) by Prof. A. Butleroff, with regard to Prof. Menshutkin's explanation of isomerism by "substitution." M. Butleroff very ably advocates the theory of "structure," *i.e.* of a combination of molecules, instead of atoms, and of compound molecules with atoms. The chief principles advocated by the author appear as follow:—We are right in speaking, as of a real thing, about mutual chemical relations between atoms and molecules; and it is only by admitting some differences in these relations (some differences in the manner of their "union") that we can explain the phenomena of isomerism. These differences are constant, permanent to the molecules; they are their inseparable characteristic attributes. These principles being admitted, the author deduces from them the following conclusions:—"(1) The scheme of substitution (advocated by Prof. Menshutkin) permits rightly to foresee and formulate isomerides only when the structure is supposed known; (2) it requires auxiliary hypotheses, and it is devoid of simplicity and lucidity; (3) the fundamental ideas, both of the theory of substitution as applied to organic bodies and of that of chemical structure, are the same; therefore the former gives nothing new which is not given by the latter; (4) being narrower and more one-sided, when applied to isomerism in organic bodies, the former—if it be applied alone—does not in many instances foretell certain phenomena which are simply and easily foreseen by the theory of chemical structure."

GEOGRAPHICAL NOTES

A BRITISH Mission from India is being sent to Cashmere in charge of Col. Lockhart, who is accompanied by Major Woodthorpe, Capt. Barrow, and Dr. Giles, and an escort consisting of two non-commissioned officers and twenty men. The chief object of the Mission is to obtain further geographical information concerning the countries on the northern and western frontiers of Cashmere. It will visit Chitral and the neighbourhood of that place, and will be absent for several months.

M. LEONARDO FÉA, of the Museum of Natural History at Genoa, has been despatched by the Italian Government on a scientific journey to Burmah. He is to make zoological collections, and also to make various scientific observations. He was provided with letters to the Burmese Government at Mandalay. The Geographical Society of Rome has received from Capt. Molinari reports of two journeys which he has recently made in the Shan States.

AT the usual meeting of the Dutch Aardrijkskundig Genootschap on April 18, a general view of those parts of New Guinea was given to which the Society wishes to send an expedition. The Government has promised a grant not exceeding 10,000 florins a year, and under such circumstances the expedition is to be confined to geographical investigations. Particulars could not yet be given, since the proposals of the Society were

still under consideration with the Government in the Dutch Indies. It was mentioned, however, that the expedition would probably go to Doreh or to Onin; many offers to accompany it have been made to the Society.

AT a recent meeting of the Paris Geographical Society, M. Romanet du Caillaud described the life and travels of Ordoñez de Cevallos, who was born at Jaen towards the middle of the sixteenth century, and who commenced his journeys all over the world at the age of seventeen. He visited various countries in Europe, and travelled several times to both Americas. He then became a priest, without, however, renouncing his dominant passion. He went as missionary to the Philippines, thence to Canton and Japan. From Japan he set sail for China again, but a storm drove him on the coasts of Tonquin. Having received permission to land, he went to the Court in 1590, and visited various parts of the Indo-Chinese peninsula, Malacca and India. He started then for Buenos Ayres, touching at the Cape of Good Hope, and endeavoured to go to the west coast of South America by the Straits of Magellan, but was prevented by an English fleet, which barred the Straits. He returned to Buenos Ayres, and in 1595 undertook a journey, similar to that in which Crévaux lost his life, by Tucuman, the Paraguay, Potosi, &c., preaching by the way to the savage tribes, whom he calls the Quixos, Omaguas, &c. He fought also agains the black Indian cannibals, called by the Spaniards the Gimarrons or Caribs. Ultimately he returned to Seville and became a canon. In 1607 the Bishop of Macao gave him a message from the King of Tonquin desiring him to return to that country, but he could not do so. The works of this indefatigable traveller are: (1) "Historia y Viage del Mundo"; (2) "Relaciones verdaderas de los Reynos de la China, Cochinchina, y Champaa" (Jaen, 1628); (3) "Triunfos de la Santissima Cruz"; (4) "Descriptio Indiæ Occidentalis," in the "Novus Orbis sive descriptio Indiæ Occidentalis" of Antonio de Herrera (Amsterdam, 1622).

A BLUE-BOOK just issued by the Foreign Office contains five maps referring to the Russo-Afghan boundaries. The first is a chart of the routes followed by members of the Boundary Commission from Kushan to Bala Murghab; the second is a reproduction in English of a Russian military map of the frontier; No. 3 is a copy of a map of South-Western Turcomania, produced in Russia; No. 4, which was prepared by M. Lessar, shows his explorations; while the last is a sketch map to illustrate the various zones and lines of frontier proposed at one time or other recently by Russia and England.

The Austrian Tourist Club has appointed a committee with the view of making experiments for the improvement of the natural drainage of certain parts of the Karst which are liable to periodical inundation. This celebrated region in the north of the Adriatic is remarkable for its underground rivers, which communicate with the surface here and there by vertical shafts. Through these openings the surplus waters escape to the surface when the underground channels are filled to overflowing, and in that way considerable tracts are periodically converted into temporary lakes. The well-known Lake Zirknitz is only one of dozens of such lakes that are formed in this district every year. The practicability of preventing these inundations by enlarging the underground channels has been discussed on several occasions in the Tourist Club, and now the first attempt to carry this scheme into effect is about to be made with the Pinka Jama, a natural shaft leading down to an underground channel about a mile and a half from the Adelsberg Cavern.

HERR GLASER, the Austrian explorer, is about to undertake a new journey in Southern Arabia. He will go first from Sanaa to Marib, and will then visit in succession Wadi-Davassir, Nedjd, Omaun, and Hadramant. In a similar journey which he made some time ago he brought back 276 inscriptions of the Sabeans, who were regarded in the time of the Ptolemys as the wealthiest people of Arabia.

CAPT. JENNINGS of the Royal Engineers, has returned to India (according to the *Pioneer*) after a successful exploration of South-eastern Persia, including the hitherto unknown Sarhad country. He carefully examined all the roads and the configuration of the country, and is said to bring back a mass of useful information with regard to this region.

THE last number (xx.) of the *Excursions et Reconnaissances* of Saigon contains, among others, two papers by that indefatigable student of Indo-China, Capt. Aymonier, one on Cambodian epigraphy, the other on a journey in Laos. Dr. Tirant gives the second part of his paper on the reptiles of Cochin China and Cambodia, and M. Hardouin concludes the account of a recent journey in Siam.

Petermann's Mittheilungen (No. 5, 1885) contains a paper, accompanied by an excellent map, on Kaffraria and the eastern boundary lands of the Cape Colony, by Herr Schunke, some observations on the sanitary features of the Upper Amu-Darya, and an account of the Geographical Congress at Hamburg.

A YEARLY AND A DAILY PERIOD IN TELEGRAPHIC PERTURBATIONS

SINCE July 1, 1881, all disturbing currents at forty-four telegraphic stations in Norway and Sweden regarding time, duration, force, direction, &c., have been at my request regularly recorded. These observations will of course first obtain real importance when a longer series is available; still, I believe it would be of interest at present to investigate whether for these telegraphic perturbations a similar yearly and daily period could be established, such as have been proved for the aurora and other terrestrial magnetic phenomena. My time being now rather limited, extensive researches are not possible; of the mentioned forty-four stations I have therefore selected four, and herewith present the results of my investigations.

The four stations are named and located as follows:—

Kistrand	70° 25′ N.	25° 13′ E.G.
Lödingen	68 24 ,,	16 1 ,,
Trondhjem	63 27 ,,	8 5 ,,
Bergen	60 24 ,,	5 20 ,,

My researches have been made for the three years from July, 1881, to June, 1884. As the Norwegian stations do not do night work, the observations could only be taken from 7 o'clock in the morning till midnight.

I have first noted the number of days for each month on which telegraphic perturbations have been observed, excluding those caused by thunderstorms. These numbers beside the totals for each month and year are shown in Tables I. to IV.

TABLE I.—*Kistrand*

Month	1881 to 1882	1882 to 1883	1883 to 1884	Total
July	1	2	8	11
August	0	12	3	15
September	7	12	11	30
October	14	20	6	40
November	10	22	3	35
December	13	8	3	24
January	5	7	0	12
February	7	10	9	26
March	13	16	4	33
April	25	6	12	43
May	19	4	3	26
June	14	5	5	24
Year	128	124	67	319

TABLE II.—*Trondhjem*

Month	1881 to 1882	1882 to 1883	1883 to 1884	Total
July	7	5	10	22
August	4	8	3	15
September	10	6	3	19
October	15	11	6	32
November	11	16	6	33
December	14	6	5	25
January	12	7	1	20
February	16	10	4	30
March	18	8	7	33
April	14	4	2	20
May	17	2	1	20
June	6	6	3	15
Year	144	89	51	284

The monthly totals for the three years are graphically represented in Fig. 1. Both the numbers and the figure show apparently that the yearly period for the telegraphic perturbations is identical with that of the aurora, *i.e.* its maximum coincides with both solstices and its minimum with both equinoxes. Of especial importance is the minimum at the time of the summer solstice, when the aurora, as is well known, ceases, on account of the

brightness of the northern nights. The perspicuity with which the yearly course of the period is drawn in the four representations of Fig. 1 may even be called surprising, considering the material of observation only embraces three years.

Fig. 1.

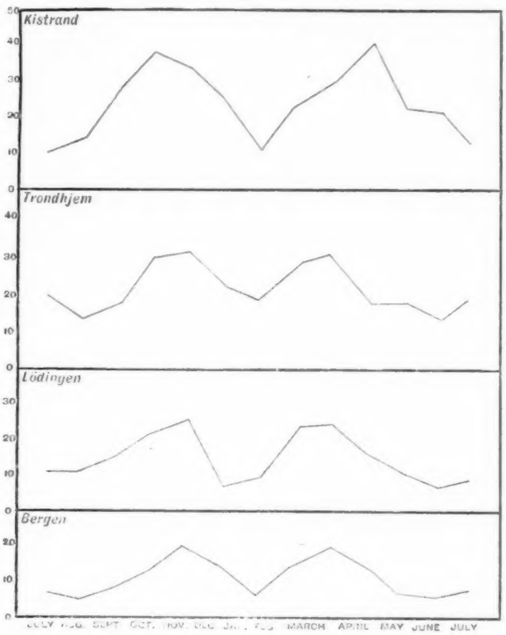


TABLE III.—*Löding n*

Month	1881 to 1882	1882 to 1883	1883 to 1884	Total
July ...	3	4	3	10
August ...	6	3	1	10
September ...	9	3	3	14
October	8	11	1	20
November ...	8	14	4	26
December ...	2	5	0	7
January ...	5	4	0	9
February ...	10	10	3	23
March...	9	9	6	24
April ..	10	4	3	17
May ...	7	3	2	12
June ...	2	6	0	8
Year ...	79	75	26	180

TABLE IV.—*Bergen*

Month	1881 to 1882	1882 to 1883	1883 to 1884	Total
July ...	2	1	3	6
August	0	3	2	5
September ..	5	1	1	7
October ...	5	3	4	12
November ...	6	10	3	19
December ...	6	6	1	13
January ...	3	1	2	6
February ...	3	9	0	12
March...	10	4	4	18
April ...	9	3	1	13
May ...	4	2	0	6
June ...	3	1	0	4
Year ...	56	44	21	121

Tables I. to IV. will show the great frequency of these telegraphic perturbations in Norway compared with those of all other countries in Europe. In the totals of the years a constant decrease for all four stations is visible which decidedly coincides with the diminishing appearance of the aurora during recent years in this country. After some years it will probably be seen how the telegraphic perturbations have the 11-year period in common with the aurora.

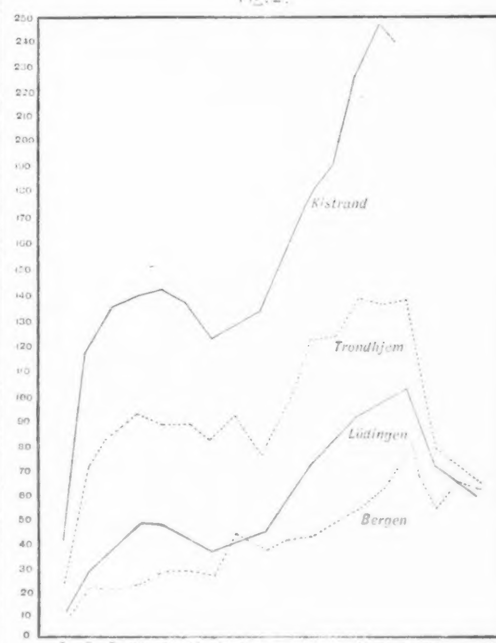
In order to determine the daily period, I have investigated how often during the three years in every hour from 7 a.m. till midnight perturbations have been observed (excluding those caused by thunderstorms). Table V. shows the result :—

TABLE V.

	7	8	9	10	11	12
Kistrand ...	42	117	135	139	141	137
Trondhjem ...	24	61	84	91	88	88
Lödingen ...	11	30	39	48	47	41
Bergen	9	23	23	24	28	29
	1	2	3	4	5	6
Kistrand ...	122	128	133	155	177	191
Trondhjem ...	81	91	75	93	120	123
Lödingen ...	36	41	43	57	70	80
Bergen	27	43	37	40	42	47
	7	8	9	10	11	12
Kistrand ...	227	247	238	—	—	—
Trondhjem ...	137	136	138	77	69	61
Lödingen ...	91	96	100	70	61	54
Bergen	52	61	77	51	61	59

Fig. 2 gives these numbers in graphic repres ntation. It will

Fig. 2.



be seen that the telegraphic perturbations show a very prominent maximum in the evening, 8 till 9 o'clock. Intimations of a trifling maximum (with the exception of Bergen) 10 till 11 a.m., and a succeeding minimum 1 to 2 p.m. are also visible.

Other occupation taking up my time at present a more extensive and detailed investigation must be postponed.

Christiania SOPHUS TROMHOLT

A NOTE RELATING TO THE HISTORY OF THE AURORA BOREALIS

AMONG northern authors none has given the writers on the Aurora Borealis more to trouble than Peder Claussön Friis, 1566-1614, Minister at Undal, near the town of Mandal, in Southern Norway. This, for his time, very productive

author, wrote, towards the end of the sixteenth century, a treatise, "About Greenland." In a second edition (about 1600) he added some extracts from the "Kings-mirror,"[1] and among these, one about the Aurora Borealis. But here he has inserted a remark, which in a high degree has attracted attention and caused astonishment, and which, till now, has been inexplicable to the investigators of the Aurora Borealis. I give further on a translation of the description of the Aurora Borealis in the "Kings-mirror," and after it the version of Peder Claussön :—

Kings-mirror

"Such a nature and condition has the north-light, that the more obscure the night, the more brilliant it appears, and only in the night is it to be seen, never during the daytime, and especially in profound darkness, but seldom by moonlight. It appears as a large flame from a heavy fire seen from afar. Out of this flame protrudes, apparently up in the air, sharp points of unequal height, and very unsteady, so that now one, then the other is higher, and in such a manner this light is pendent like a luminous blaze. As long as these flashes are most intense and bright, such a keen light radiates from these streams of fire and rays, that outdoor people can find their way, and even go a hunting, if it should be necessary. Also, when people are in houses provided with windows, it is so bright inside that all present can recognise each other. But this light is so fluctuating that it sometimes seems to darken, as if a black smoke or a heavy nebulous cloud had been puffed into it, and then shortly again it seems as if the light were about to be smothered in this smoke, and almost become quite extinct. But as soon as this fog commences to dissolve, then this light brightens, and clears up for the second time, and it happens even that one would believe that heavy sparks emitted from it as from a red-hot iron just taken out of the forge. When the night declines, and with daybreak this light begins to decrease, and when the day has set in it seems entirely to disappear."

Peder Claussön Friis

"In Greenland a meteor and bright light is seen on the sky during the night, which appears in the following manner: the more obscure the night the more brilliant is the light; that is to say, the less the moon shines, *and when she is in her prime or wane, the more this light becomes visible in the sky, however, always towards the north*, AND NEVER SO HIGH IN THE SKY AS TO BE OBSERVED IN OTHER COUNTRIES THAN GREENLAND, ICELAND, AND THE NORTHERN PART OF NORWAY, *and for that reason it is called North-light.*

"It appears as a flame or a *darting fire*, and extends over the sky *like a tall and slender hedge*, and it rushes *up and down in a trice as if many organ pipes were posted one beside the other, and in the twinkling of an eye one shoots up and the other down, and where the flame darts clearest up and down, back and forwards*, it can grow dim and almost leave behind it a smoke; *but the next moment* light up again *on another spot, or catch fire where it just before seemed to be extinguished. Nobody who has not himself seen it, can imagine how quickly this light moves forwards and backwards, as if it were hopping and dancing with much agitation.* And when this light is most intense, people can perceive everything in the houses *as if the moon were shining.* At daybreak this northlight fades away."

The "Kings-mirror" was written about 1250, at all events before 1260, and probably later than 1240. The home of the unknown, but at all events Norwegian, author may be looked for, according to the sagacious reasoning of H. Geelmuyden (Christiania Observatory) between 64° 23′ and 64° 58′ N. lat. (not far from the town of Namsos). This description of the aurora is indeed unparalleled in the aurora literature of the past ages; the noble but unvarnished manner in which he describes the phenomenon has not a counterpart in the same or at a much later period. It is peculiar, however, that the aurora is mentioned in the "Kings-mirror" as a phenomenon chiefly characteristic of Greenland, and not even an intimation is given as to its being visible in Norway. This description indicates, nevertheless, quite plainly that it is based on the author's own observation of the aurora in his native country, and it is therefore beyond doubt that he was familiar with the phenomenon,[1] although he has considered Greenland—the country situated, according to the opinion of past ages, farthest towards the north—the proper home of the aurora.

In Peder Claussön's above quoted version of the aurora description in the "Kings-mirror" I have made the remarks and expressions differing from the "Kings-mirror" conspicuous by italics. It will be seen that his citation is rather free; many of these conspicuous expressions, if not all, point to Peder Claussön's knowledge of the aurora through his own observation. The more striking is the conspicuous remark that the aurora in Greenland does not appear so high in the sky as to be observed in other countries than Greenland, Iceland, and the northern part of Norway.

This remark has been inserted in many other publications, and all historians of the aurora from Mairan to Fritz have occupied themselves with the notable circumstance that, according to this remark, the aurora was not visible during the last half of the sixteenth century in Southern Norway. But nowhere in the whole history of the aurora is it so evident how much caution must be displayed in drawing comprehensive inferences from a single remark of an old author.

Peder Claussön has, in a single copy of his treatise on Greenland in the year 1604 or 1605, with regard to the aurora, added the following important "note," hitherto unknown to the investigators of the aurora :—

"This northlight was, as before said, only seen in past times in northern countries. But in the period of my infancy, about the year 1550, it was first seen by people who live in the southern part of Norway, however not higher on the sky than the Polar Star. But since the year 1570 it ascends to such a height that it appears to us in the south-east and in a southern direction, and I suppose that it is seen at present also in other countries."

Peder Claussön's relation is thus in downright contradiction with the interpretation given to his above-mentioned remark. It remains now to explain how he could write, in the year 1600, that the aurora was only visible in the extreme north of Norway. It may be seen that he had the opinion that the aurora, in "past times," was only visible in "the northern countries"; the silence of the "Kings-mirror" about this phenomenon in Norway has perhaps brought him to this conclusion. The remark "and never so high in the sky as to be observed," &c., therefore, in all probability describes the circumstances which, after his opinion, took place at the time when the "Kings-mirror" was written. The additional clause, "and for that reason it is called northlight," seems at the same time to intimate that he, by the previous remark, would explain why the author of the "Kings-mirror" uses the expression northlight (namely, because it is visible only in the extreme northern countries).

SOPHUS TROMHOLT

Christiania

[1] The Kings-mirror (Konungs skuggsjá) is, of its kind, an unparalleled Norwegian work, in which an ingenious and noble man, who must have stood at the height of culture at his time, has expounded his philosophy and especially his views on State administration and ethics, in the form of conversations between a father and son. It is a book on good manners, social intercourse of the highest interest, because of the whole form of culture which it represents, and is written in elevated tone.

[1] The author himself never visited Greenland.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Two studentships have been established at St. John's College on the foundation of the Rev. Mr. Hutchinson, late Senior Fellow. They are of the value of 60*l.* a year for two years and are tenable with a Foundation Scholarship. Any student of the College who shall be *bonâ fide* engaged in the pursuit of some branch or branches of physical or natural science or in the study of Semitic or Indian languages, and shall be of not less than nine and not more than eighteen terms' standing from the commencement of his residence in the University shall be qualified to be a candidate, and if there is no candidate belonging to the College of sufficient merit in these studies, the Council may elect a student engaged in any study, whether a member of the College or not. The Council may impose such conditions on the students as shall encourage genuine study after the best methods—*e.g.* they may require him to present in writing an account of his studies, to deliver lectures, &c. The election will take place in June each year.

It will be seen that a Hutchinson student may be free to work at biology in Naples, to join an Eclipse Expedition, to study Pali in Ceylon or Hebrew in Cambridge. We hope to hear of the Hutchinson students in the future.

The Senate has approved of the erection of a new Chemical

Laboratory according to Mr. Stevenson's design, and tenders are to be obtained as early as possible.

Mr. J. W. L. Glaisher, F.R.S., is to be Additional Examiner in Part III. of the Mathematical Tripos in January, 1886.

Prof, Bonney and Mr. J. J. H. Teall are appointed Examiners for the Sedgwick Prize to be adjudged next year.

Prof. Macalister will take a class in Osteology during the Long Vacation. There will also be an Introductory Practical Course in Anatomy, illustrated by that of the Dog, superintended by the Professor and Mr. Rolleston. The Demonstrator will take a practical class in Histology during the Long Vacation.

SCIENTIFIC SERIALS

Journal of Anatomy and Physiology, vol. xix., Part 3, April 1, contains:—On the development of the blood-corpuscles in the embryo of *Perca fluviatilis*, by K. F. Wenckebach (plate 11).—Movements of the ulna in rotation of the fore arm, by Dr. J. Heiberg.—The nature of ligaments, part iii., by J. B. Sutton (plate 12).—Supernumerary cervico-dorsal vertebra-bearing ribs, with vertebral and costal asymmetry; abnormal articulation in a sternum, by W. A. Lane.—Some points in the histology of the medulla oblongata, pons varolii, and cerebellum, by Dr. W. A. Hollis (plate 13).—The external auditory meatus in the child; the relations of the larynx and trachea to the vertebral column in the fœtus and child; a rare abnormality of the pancreas, by Dr. J. Symington (plate 14).—The existence of a fourth species of the genus Balænoptera, by Dr. G. A. Guldberg.—Some variations in the anatomy of the human liver.—Notes on some unusual variations in human anatomy, by Dr. A. Thomson.—Observations in reference to bilateral asymmetry of form and function, by Dr. F. Tuckerman.—Case of exostosis of the ulna, by Dr. R. J. Anderson.—The musculus sternalis and its occurrence in (human) Anencephalous monsters, by Dr. F. J. Shepherd (plate 15).—The venous system of the bladder and its surroundings, by E. H. Fenwick (plate 16).

The Journal of Physiology, vol. v., Nos. 4, 5, 6, contains:—Observations of the gastric glands of the pig, by M. Greenwood.—Hæmatin compounds, by V. D. Harris.—Papain digestion, by S. H. C. Martin.—The secretion of oxalic acid in the dog under a varying diet, by T. W. Mills.—On the comparison of the concentrations of solutions of different strength of the same absorbing substance, by S. Lea.—On the mutual antagonism between lime and potash salts in toxic doses, by S. Ringer.—The behaviour of the red blood corpuscles, when shaken with indifferent substances, by S. J. Meltzer and W. H. Welch.—On the cardiac rhythm of Invertebrata, by W. B. Ransom.—Some experiments on the liver ferment, by Florence Eves.—An experimental investigation showing that Veratria is similar to lime salts in many respects as regards their action on the ventricle; also showing that veratria and lime salts are reciprocally antagonistic, by S. Ringer.—Some observations on the influence of the vagus and accelerators on the heart of the turtle, by T W. Mills.—On the anatomy of the cardiac nerves in certain cold-blooded vertebrates, by W. H. Gaskell and Hans Gadow.

Vol. vi., Nos. 1 and 2.—Is the nervous impulse delayed in the motor nerve terminations? by A. W. Hoisholt.—Observations on some of the colouring matters of bile and urine, with special reference to their origin; and on an easy method of procuring hæmatin from blood, by C. A. MacMunn.—The edible bird's nest, or nest of the Java swift (*Callocalia nidifica*), by J. R. Green.—The velocity of accommodation, by J. W. Barrett.—On the physiology of the salivary secretion; part 3, the paralytic secretion of saliva, by J. N. Langley.

Gegenbaur's Morphologisches Jahrbuch, Bd. x., Heft 4, contains: On the morphology of nails, by C. Gegenbaur.—On direct nuclear division in the embryonal membranes in the scorpion, by F. Blochmann (plate 22).—On the derivation of the neural system in the nematodes, by O. Butschli (plate 23).—Studies on the developmental history of the cœloms and Cœlom-epithelial in the amphibia, by B. Solger (plates 24 and 25).—Some remarks on the true relations of organisation in the so-called cilio-flagellates, and in the noctiluca, by O. Butschli; with a note by E. Askenasy (plates 26 to 28).—The foramen magendii, and the opening in the recessus laterales of the fourth ventricle, by C. Hess (plate 29).—Reply to Dr. Baur, by Dr. W. Dames.—On the beaks of birds and dinosaurs, by Dr. G. Baur.

Zeitschrift für Wissenschaftliche Zoologie, Band xli., Heft 3, contains:—On the history of the formation and on the morphological value of the ova of *Nepa cinerea* and *Notonecta glauca*, by W. Will (plates 20-22).—On the powers of transformation in the Mexican Axolotl, by Marie von Chauvin.—Contribution to a knowledge of the Trematodes, *Distomum palliatum*, nov. spec., and *D. reticulatum*, nov. spec., by A. Looss (plate 23).—The formation of the radula in the Cephalophorus Mollusca, by R. Rossler (plates 24 and 25).—Studies of the fauna of the larger and smaller ponds in the Riesengebirge, by O. Zacharias (plate 26).—On some common developmental processes in Vertebrates, by J. Kollman.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 23.—"The Essential Nature of the Colouring of Phytophagous Larvæ (and their pupæ); with an account of some Experiments upon the Relation between the Colour of such Larvæ and that of their Food-plants," by Edward B. Poulton, M.A., of Jesus and Keble Colleges, Oxford.

Abstract.

The Essential Nature of the Colouring of Phytophagous Larvæ.—Phytophagous larvæ are coloured by pigments derived from the food-plant, pigments proper to the larvæ, and tissues such as fat, which lend incidental aid to the colouring. The altered plant-pigments hitherto detected in larvæ are chlorophyll and xanthophyll, causing the colours green and yellow. The former is termed metachlorophyll, because of the difference between its spectrum and that of unaltered chlorophyll (in the leaf), and because of the chemical differences between its solution in larval blood, &c., and any known solution of plant chlorophyll. The evidence is at present insufficient to warrant the use of a separate name for the derived larval xanthophyll. Other colours hitherto examined are due to true pigments or tissues.

The following table indicates the situations occupied by the different causes of colour, and gives to some extent the historic order of their employment.

I. The internal tissues and organs with ready-made colour	*a*. Digestive tract. *b*. Fat. *c*. Dorsal vessel.
II. The passage of derived pigments through the walls of the digestive tract into	*a*. The blood. *b*. The subcuticular tissues.
III. The appearance of true pigment in	*a*. The hypodermis. *b*. The cuticle.

These causes explain larval and pupal colour, except such instances as the metallic tints of certain pupæ. The different stages of coloration mentioned in the table were not often mutually exclusive, but each new method was an additional resource. The derived pigments more often confer general resemblances, the true pigments special resemblances. In many cases the green colour is due to metachlorophyll in the blood only (many Noctuæ), while in other cases it is also placed in the subcuticular tissues (Sphingidæ). The former larvæ lose their colour locally on slight compression, while the swollen uncompressed part becomes of a deeper tint. When larvæ are dimorphic—green and brown—the colours of the former are mainly due to metachlorophyll, of the latter to true pigments. Such important differences in the causes of colour commonly occur among larvæ from the same batch of eggs, or in the life-history of a green larva, which becomes brown, or *vice versa*. The blood of brown larvæ, with transparent skins, is colourless except in very thick layers; in the brown *Chærocampa elpenor*, the blood becomes brown, but the bands of metachlorophyll and xanthophyll can be faintly seen. Hence these pigments are not destroyed beyond the point at which they cease to interfere with the changed colour. The derived pigments may exist unchanged in the blood after the larva has altered in colour, if the superficial pigments are completely opaque (many geometers). This persistence of the derived pigments may be very important to the organism. Thus the larva of *Ennomos angularia* is an opaque brown geometer, but pupates in a cocoon of loosely-attached leaves through which it can be seen. Before pupation the true pigment disappears, and the larva and pupa are coloured by metachlorophyll. Again, in many instances the derived pigments are retained in the blood of the pupa and segregated in the ova, when these are yellow or green, serving to tinge the newly-hatched larva before the effects of its first meal can become apparent. But after such a long period, and the alternation of solution in blood and deposition in tissue, the

colour of the more stable pigment—xanthophyll—preponderates over the green of the metachlorophyll in the newly-hatched larva. The bands of xanthophyll are distinctly seen in an alcoholic extract of crushed ova taken from the bodies of moths which have been preserved for ten years or longer. In blown and dried larvæ the greens soon fade, while the yellows persist and the pigment can be detected after many years. The true pigments are also unaltered. In larvæ preserved in spirit the derived pigments quickly disappear, and the alcohol is yellow with xanthophyll, while the true pigments are unchanged. These facts are also true of phytophagous hymenopterous larvæ, as well as in the lepidoptera. Thus in *Nematus curtispina* the green colour is due to derived pigment, while the broad white dorsal band is due to fat collected on each side of the dorsal vessel (and it can be seen to move with the pulsations of the latter). In *Crœsus Septentrionalis* fat becomes the vehicle for a yellow colour. The few exposed pupæ of moths are coloured in the same manner as the larvæ (*e.g.* the *Ephyridæ* and *E. angularia*). In the Ephyridæ, dimorphic larvæ—green and brown—produce pupæ which follow the colour of their respective larvæ. Larval markings can often be seen upon the pupa immediately after pupation. Thus the pupa of *Sphinx ligustri* is marked by the oblique stripes of the larva. The pupæ of butterflies are nearly always protectively coloured, and often possess the derived pigments. In *Papilio machaon* the derived pigments of the pupa are segregated in a very remarkable chitinised (?) subcuticular layer, which is quite opaque, so that no effect is produced by the bright yellow blood (xanthophyll).

Methods of Investigation and Spectra of derived Pigments.—Zeiss's micro-spectroscope was always employed, with bright sunlight as the means of illumination. The blood is obtained by pricking the pupa or the larva in some situation remote from the digestive tract. Existing under pressure, most of the blood at once emerges as a clear bright green or yellow liquid (when the derived pigments are present). It is received into a tube-section, with one end cemented to a glass slide, and when full a cover glass is placed upon the open end, becoming fixed by the drying of the blood. In most cases the blood so prepared will keep for months. The spectrum of metachlorophyll is as follows (in the case of the bright green fresh blood of the pupa of *Pygæra bucephalus* in a thickness of 23 mm.):—

Chief band in the red, 71·–65·, continuous with a less absorption extending to 58·, darkest from 58·5–59·5; a broad band from 52·–48· with the dimmed blue and violet coming through 48·–42·, from which latter point the violet end is absorbed. There is no absorption of the extreme red. A Zeiss's scale is adopted in which 1·=1/100,000 mm.

Comparing this spectrum with that of true chlorophyll, as seen in two fresh calceolaria leaves, the whole spectrum is shifted towards the violet end in the latter case, with the exception of the end absorption, which extends to 43·. The chief band in the red is 70·–64·5, and then the continuous absorption of metachlorophyll is replaced by two bands: 61·–63· and 57·5–60·, and if anything the former is the darker. The broad band is 47·5–51·, and the dimmed blue and violet 47·5–43·. The chief difference is the continuity of the three bands of the red end in metachlorophyll, and the fact that their darkness is in the order (1) (3) (2) from the red, instead of (1) (2) (3). A similar spectrum (as far as it could be identified by the use of a paraffin lamp) was observed in a clear green fluid from the digestive tract of the larva of *Phlogophora meticulosa*. In yellowish green blood (pupa of *S. ligustri*) the absorption at the violet end is aided by the xanthophyll present, which gives two bands if the thickness of blood be sufficiently small. In some cases a third band is also present. Thus the blood of *S. ligustri* in a thickness of 3 mm. does not give the band of chlorophyll in the red, but shows three bands in the more refrangible half of the spectrum: 48·–50·, 45·–46·25, and 42·–43· the violet end being absorbed at 41·. Between these areas of absorption the spectrum is dimmed. The three bands become less distinct in the above-mentioned order, and the third can only be seen under favourable conditions of light, and appears to be absent in some cases. Mr. Sorby states that a third band, due to another substance, is sometimes present in the xanthophyll spectrum. While the spectrum of metachlorophyll is very constant over a large number of larvæ and pupæ, in the living green pupa of *Ephyra punctaria*, a form of chlorophyll with a rather different spectrum was met with, in which the second band of true chlorophyll is present instead of the continuous absorption, while the third band could not be seen in the slight thickness obtainable. The term "ephyra-chlorophyll" is given to this pigment, which is dissolved in the blood of the pupa. Metachlorophyll, and probably xanthophyll, are united with a proteid in the blood. The addition of ether to green blood brings down the combined pigment and proteid in the form of a green coagulum, from which the ether does not dissolve the metachlorophyll, but gradually takes up the xanthophyll, becoming bright yellow. Alcohol, on the other hand, decomposes the combined proteid and pigments, the coagulum rapidly becoming decolorised, and the xanthophyll passing at once into solution, while the metachlorophyll disappears. Hence it seems that the latter pigment depends upon its association with the proteid for its extreme stability and permanence under the action of light. This permanence is necessary for the larva, since any colour due to derived pigments implies the penetration of light, and often the complete translucence of the whole organism, and, further, there are long periods (at the ecdyses), during which the pigments cannot be renewed, because no food is taken. Then there are the extreme cases of the green Ephyra pupæ, and the green pupæ of *P. machaon*, freely exposed to daylight during two-thirds of the year. It seems certain that the derived pigments are merely protective, and are of no further importance in the physiology of these organisms. Thus it is not probable that there are any marked differences between the physiological processes of the green and brown larvæ from the same batch of eggs, or in the processes of a green larva which has become brown, or *vice versâ*. The blood of larvæ seems to be always acid (and so with all pupæ examined, except *E. punctaria*, of which the blood was neutral, in the only instance in which the blood of this pupa was tested), but I have as yet been unable to obtain a sufficient quantity of blood to determine what acid is present. The blood forms a solid, black coagulum which is due to oxidation, and does not take place when the blood is preserved in the manner described above. The injured parts of larvæ which have healed are black. It is probable that the darkening of pupæ and of the cuticular pigment of larvæ is also due to oxidation. There is great variability in the amount of clot formed and in the rapidity of the process.

Historical.—Mr. Raphael Meldola, in the *Proc. Zool. Soc.* for 1873, and in the editorial notes to his translation of Weismann's "Studies in the Theory of Descent," Part. II., "On the Origin of the Markings of Caterpillars," &c., argues very convincingly for the use of plant-pigments by green larvæ He points out that internal feeders are never green unless their food contains chlorophyll, and that when this is the case (*Nepticula oxyacanthella*, &c.) they may be green, although the colour cannot be of any advantage to them. Pocklington (confirmed by Dr. MacMunn) found chlorophyll in the elytra of Cantharides, and Chautard seems doubtful about the same pigment in this situation (*Compt. Rend.*, January 13, 1873, and *Ann. Chim. Phys.*, 5, iii., 1-56). Dr. MacMunn found a band in the red which resembled chlorophyll, by concentrating light on the integument of the larva of *Pieris rapæ* and examining with a micro-spectroscope; but both he and Krukenberg refer the pigment to the larval digestive tract. (See *Reports* of British Association at Southport, 1883, and a letter by Dr. MacMunn to NATURE for the week ending January 10, 1885). It is very unlikely that the green colour of so thick and opaque a larva can be due to its digestive tract, and it is probable that the blood, with its dissolved metachlorophyll, was lost in the manipulation. From memory of the appearance of the larva, and from examining a blown specimen, I should certainly infer that there are also derived pigments in the subcuticular tissues.

The Relations between the Colour of Phytophagous Larvæ and that of their Food-Plants.—Entomologists have been long aware of the fact that the colours of many larvæ vary (within the limits of the same species) according to the colour of the plant upon which they are found. Complete references to the observations hitherto recorded upon this point occur in Mr. Meldola's writings (mentioned above). Among the most important of these is a paper by Mr. R. M'Lachlan (*Trans. Ent. Soc*, 1865, p. 453) in which data are given as to *Eupithecia absynthiata*, which were yellowish when found upon *Senecio jacobæa*, reddish upon *Centaurea nigra*, whitish upon Matricaria. When nearly full grown they were all given *Senecio jacobæa* without altering the colour of the reddish and whitish varieties. From this Mr. M'Lachlan argued (1) that it was necessary for the larvæ to have fed on the one kind of plant from the egg to acquire the resemblance; (2) that the colour is not caused by the food showing through the somewhat transparent integument. Mr. Meldola

quotes many instances in which the larva of *S. ligustri* has been observed to vary according to its food-plant (laurustinus, lilac, privet, ash). I have for many years known of the difference between the lilac and privet forms (the latter being of a brighter yellower green than the former, with brighter stripes). In 1884 I bred twelve larvæ from the egg upon privet, and the same number upon lilac. All the privet and six of the lilac larvæ reached maturity, and, without exception, showed the differences indicated above. A more remarkable instance is afforded by *Smerinthus ocellatus*. Mr. Meldola quotes Mr. E. Boscher as finding many yellowish-green varieties of this larva upon *Salix viminalis*, and many bluish-green varieties upon *S. triandra*, similar to those which are well known to occur upon apple. The former varieties possessed the rows of reddish-brown spots which sometimes occur on this variety of the larva. Upon another species of Salix he found instances of both varieties. In 1880 Mr. Boscher conducted some breeding experiments at Mr. Meldola's suggestion, feeding the larvæ from the egg upon *S. triandra*, *S. viminalis*, and apple, respectively. Only three of the third lot survived, and were all of the bluish-green form. I have also found (*Trans. Ent. Soc.*, Part I., April, 1884) that *S. rubra* and *S. cinerea* produce the yellowish variety, but *S. viminalis* the bluish form, according to my experience. In 1884 I fed five lots of six larvæ each, from the egg, upon apple, crab, *Salix viminalis*, *S. cinerea*, and *S. rubra*, respectively. On a few occasions *S. babylonica* and *triandra* were substituted for *S. rubra*, and ordinary apple for crab. The eggs were hatched July 15 to 18, and most of the larvæ were full fed by August 23, with the following results:—*Apple*: the five larvæ were typical bluish-green forms. *Crab*: the five larvæ were also typical bluish-green. *S. viminalis*: the four larvæ were not so whitish as the above-mentioned lots, but were almost intermediate. *S. cinerea*: the four larvæ were also intermediate. *S. rubra*: the four larvæ were yellower than any of the others, but were not much beyond intermediate forms. The yellowest was separated on August 14, and fed upon apple, becoming adult August 26, by which time it was rather whiter than any others of the same lot (*S. rubra*).

Thus there was no doubt about the effects produced, but there was a strong tendency all through towards the bluish variety, which the food-plant could only overcome to the extent of producing an intermediate form. The same conclusions were formed by a comparison of larvæ found in the field during 1884. Thus two nearly opposite varieties were found upon the same tree (? *S. ferruginea*, Anderson); an intermediate variety was found upon *S. rubra*, and a bright yellowish variety upon apple. At the same time the great majority of larvæ found were such as I should have anticipated.

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Chemical Society, May 7.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following papers were read:—On some points in the composition of soils; with results illustrating the sources of fertility of Manitoba prairie soils, by Sir J. B. Lawes, Bart., LL.D., F.R.S., F.C.S., and J. H. Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.—Researches on the relation between the molecular structure of carbon compounds and their absorption spectra, by Prof. W. N. Hartley, F.R.S. In continuation of the author's previous researches (*Trans.*, 1881, 57-60 and 111-128; 1883, 676-678), measurements have been made of the wave-lengths of the rays absorbed by the following substances:—(1) Aromatic hydrocarbons: benzene, the three xylenes, and naphthalene. (2) Aromatic tertiary bases and their salts: pyridine, picoline, quinoline, and their hydrochlorides. (3) Addition products of tertiary bases and salts: piperidine, tetrahydroquinoline, and its hydrochloride. (4) Primary aromatic bases or amido-derivatives and salts thereof: ortho- and para-toluidine and their hydrochlorides. In the preparation of solutions, a milligram-molecule, that is, the molecular weight

colour of the more stable pigment—xanthophyll—preponderates over the green of the metachlorophyll in the newly-hatched larva. The bands of xanthophyll are distinctly seen in an alcoholic extract of crushed ova taken from the bodies of moths which have been preserved for ten years or longer. In blown and dried larvæ the greens soon fade, while the yellows persist and the pigment can be detected after many years. The true pigments are also unaltered. In larvæ preserved in spirit the derived pigments quickly disappear, and the alcohol is yellow with xanthophyll, while the true pigments are unchanged. These facts are also true of phytophagous hymenopterous larvæ, as well as in the lepidoptera. Thus in *Nematus curtispina* the green colour is due to derived pigment, while the broad white dorsal band is due to fat collected on each side of the dorsal vessel (and it can be seen to move with the pulsations of the latter). In *Crœsus Septentrionalis* fat becomes the vehicle for a yellow colour. The few exposed pupæ of moths are coloured in the same manner as the larvæ (*e.g.* the *Ephyridæ* and *E. angularia*). In the Ephyridæ, dimorphic larvæ—green and brown—produce pupæ which follow the colour of their respective larvæ. Larval markings can often be seen upon the pupa immediately after pupation. Thus the pupa of *Sphinx ligustri* is marked by the oblique stripes of the larva. The pupæ of butterflies are nearly always protectively coloured, and often possess the derived pigments. In *Papilio machaon* the derived pigments of the pupa are segregated in a very remarkable chitinised (?) subcuticular layer, which is quite opaque, so that no effect is produced by the bright yellow blood (xanthophyll).

Methods of Investigation and Spectra of derived Pigments.—Zeiss's micro-spectroscope was always employed, with bright sunlight as the means of illumination. The blood is obtained by pricking the pupa or the larva in some situation remote from the digestive tract. Existing under pressure, most of the blood at once emerges as a clear bright green or yellow liquid (when the derived pigments are present). It is received into a tube-section, with one end cemented to a glass slide, and when full a cover glass is placed upon the open end, becoming fixed by the drying of the blood. In most cases the blood so prepared will keep for months. The spectrum of metachlorophyll is as follows (in the case of the bright green fresh blood of the pupa of *Pygæra bucephalus* in a thickness of 23 mm.):—

Chief band in the red, 71·–65·, continuous with a less absorption extending to 58·, darkest from 58·5–59·5; a broad band from 52·–48· with the dimmed blue and violet coming through 48·–42·, from which latter point the violet end is absorbed. There is no absorption of the extreme red. A Zeiss's scale is adopted in which 1· = 1/100,000 mm.

Comparing this spectrum with that of true chlorophyll, as seen in two fresh calceolaria leaves, the whole spectrum is shifted towards the violet end in the latter case, with the exception of the end absorption, which extends to 43·. The chief band in the red is 70·–64·5, and then the continuous absorption of metachlorophyll is replaced by two bands: 61·–63· and 57·5–60·, and if anything the former is the darker. The broad band is 47·5–51·, and the dimmed blue and violet 47·5–43·. The chief difference is the continuity of the three bands of the red end in metachlorophyll, and the fact that their darkness is in the order (1) (3) (2) from the red, instead of (1) (2) (3). A similar spectrum (as far as it could be identified by the use of a paraffin lamp) was observed in a clear green fluid from the digestive tract of the larva of *Phlogophora meticulosa*. In yellowish green blood (pupa of *S. ligustri*) the absorption at the violet end is aided by the xanthophyll present, which gives two bands if the thickness of blood be sufficiently small. In some cases a third band is also present. Thus the blood of *S. ligustri* in a thickness of 3 mm. does not give the band of chlorophyll in the red, but shows three bands in the more refrangible half of the spectrum: 48·–50·, 45·–46·25, and 42·–43· the violet end being absorbed at 41·. Between these areas of absorption the spectrum is dimmed. The three bands become less distinct in the above-mentioned order, and the third can only be seen under favourable conditions of light, and appears to be absent in some cases. Mr. Sorby states that a third band, due to another substance, is sometimes present in the xanthophyll spectrum. While the spectrum of metachlorophyll is very constant over a large number of larvæ and pupæ, in the living green pupa of *Ephyra punctaria*, a form of chlorophyll with a rather different spectrum was met with, in which the second band of true chlorophyll is present instead of the continuous absorption, while the third band could not be seen in the slight thickness obtainable. The term "ephyra-chlorophyll" is given to this pigment, which is dissolved in the blood of the pupa. Metachlorophyll, and probably xanthophyll, are united with a proteid in the blood. The addition of ether to green blood brings down the combined pigment and proteid in the form of a green coagulum, from which the ether does not dissolve the metachlorophyll, but gradually takes up the xanthophyll, becoming bright yellow. Alcohol, on the other hand, decomposes the combined proteid and pigments, the coagulum rapidly becoming decolorised, and the xanthophyll passing at once into solution, while the metachlorophyll disappears. Hence it seems that the latter pigment depends upon its association with the proteid for its extreme stability and permanence under the action of light. This permanence is necessary for the larva, since any colour due to derived pigments implies the penetration of light, and often the complete translucence of the whole organism, and, further, there are long periods (at the ecdyses), during which the pigments cannot be renewed, because no food is taken. Then there are the extreme cases of the green Ephyra pupæ, and the green pupæ of *P. machaon*, freely exposed to daylight during two-thirds of the year. It seems certain that the derived pigments are merely protective, and are of no further importance in the physiology of these organisms. Thus it is not probable that there are any marked differences between the physiological processes of the green and brown larvæ from the same batch of eggs, or in the processes of a green larva which has become brown, or *vice versâ*. The blood of larvæ seems to be always acid (and so with all pupæ examined, except *E. punctaria*, of which the blood was neutral, in the only instance in which the blood of this pupa was tested), but I have as yet been unable to obtain a sufficient quantity of blood to determine what acid is present. The blood forms a solid, black coagulum which is due to oxidation, and does not take place when the blood is preserved in the manner described above. The injured parts of larvæ which have healed are black. It is probable that the darkening of pupæ and of the cuticular pigment of larvæ is also due to oxidation. There is great variability in the amount of clot formed and in the rapidity of the process.

Historical.—Mr. Raphael Meldola, in the *Proc. Zool. Soc.* for 1873, and in the editorial notes to his translation of Weismann's "Studies in the Theory of Descent," Part. II., "On the Origin of the Markings of Caterpillars," &c., argues very convincingly for the use of plant-pigments by green larvæ. He points out that internal feeders are never green unless their food contains chlorophyll, and that when this is the case (*Nepticula oxyacanthella*, &c.) they may be green, although the colour cannot be of any advantage to them. Pocklington (confirmed by Dr. MacMunn) found chlorophyll in the elytra of Cantharides, and Chautard seems doubtful about the same pigment in this situation (*Compt. Rend.*, January 13, 1873, and *Ann. Chim. Phys.*, 5, iii., 1–56). Dr. MacMunn found a band in the red which resembled chlorophyll, by concentrating light on the integument of the larva of *Pieris rapæ* and examining with a micro-spectroscope; but both he and Krukenberg refer the pigment to the larval digestive tract. (See *Reports* of British Association at Southport, 1883, and a letter by Dr. MacMunn to NATURE for the week ending January 10, 1885). It is very unlikely that the green colour of so thick and opaque a larva can be due to its digestive tract, and it is probable that the blood, with its dissolved metachlorophyll, was lost in the manipulation. From memory of the appearance of the larva, and from examining a blown specimen, I should certainly infer that there are also derived pigments in the subcuticular tissues.

The Relations between the Colour of Phytophagous Larvæ and that of their Food-Plants.—Entomologists have been long aware of the fact that the colours of many larvæ vary (within the limits of the same species) according to the colour of the plant upon which they are found. Complete references to the observations hitherto recorded upon this point occur in Mr. Meldola's writings (mentioned above). Among the most important of these is a paper by Mr. R. M'Lachlan (*Trans. Ent. Soc*, 1865, p. 453) in which data are given as to *Eupithecia absynthiata*, which were yellowish when found upon *Senecio jacobæa*, reddish upon *Centaurea nigra*, whitish upon Matricaria. When nearly full grown they were all given *Senecio jacobæa* without altering the colour of the reddish and whitish varieties. From this Mr. M'Lachlan argued (1) that it was necessary for the larvæ to have fed on the one kind of plant from the egg to acquire the resemblance; (2) that the colour is not caused by the food showing through the somewhat transparent integument. Mr. Meldola

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Chemical Society, May 7.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following papers were read:—On some points in the composition of soils; with results illustrating the sources of fertility of Manitoba prairie soils, by Sir J. B. Lawes, Bart., LL.D., F.R.S., F.C.S., and J. H. Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.—Researches on the relation between the molecular structure of carbon compounds and their absorption spectra, by Prof. W. N. Hartley, F.R.S. In continuation of the author's previous researches (*Trans.*, 1881, 57-60 and 111-128; 1883, 676-678), measurements have been made of the wave-lengths of the rays absorbed by the following substances:—(1) Aromatic hydrocarbons: benzene, the three xylenes, and naphthalene. (2) Aromatic tertiary bases and their salts: pyridine, picoline, quinoline, and their hydrochlorides. (3) Addition products of tertiary bases and salts: piperidine, tetrahydroquinoline, and its hydrochloride. (4) Primary aromatic bases or amido-derivatives and salts thereof: ortho- and para-toluidine and their hydrochlorides. In the preparation of solutions, a milligram-molecule, that is, the molecular weight

in milligrams, was dissolved in 20 c.c. of a diactinic solvent, and made up to a given volume, generally 20 c.c. In this way molecular weights were made to occupy equal volumes. Photographs of the absorption spectra were taken through definite thicknesses of solution. The lines of tin, lead, and cadmium were used as references; the positions of the bands were measured on the photographs by means of an ivory rule divided into hundredths of an inch, and those measurements were reduced by means of two curves to oscillation frequencies and wave-lengths. As far as possible, the absorption curves are drawn to a uniform scale. These curves indicate the *molecular actinic absorption* of each substance. The following deductions are drawn:—When an atom of nitrogen is substituted for an atom of carbon in the benzene or naphthalene nucleus, the property of selective absorption is still retained. When the condensation of the carbon and nitrogen in the molecule of a benzenoid compound or tertiary base is modified by the addition of an atom of hydrogen to each atom of carbon and nitrogen, the power of selective absorption is destroyed. When the condensation of the carbon in quinoline is modified by the combination therewith of four atoms of hydrogen, the intensity of the selective absorption is reduced and is not destroyed. A very pure specimen of quinoline from coal-tar gave an absorption curve identical with that of quinoline prepared synthetically by Skraup's method. It may further be added that molecular actinic absorption of a salt is different from that of the organic base which it contains, although the acid exerts no absorptive power by itself. Sometimes the difference is very great, but the area included by the curve of the salt is always less than that of the base. Molecules vibrate as wholes or units, and the fundamental vibrations give rise to secondary vibrations which stand in no obvious relation to the chemical constituents of the molecule, whether these be atoms or smaller molecules. Hence it appears that a molecule is a distinct and individual particle which cannot be truly represented by our usual chemical formulæ, since these only symbolise certain chemical reactions and physical properties, and fail to express any relation between physical and chemical properties.—Researches on the action of the copper-zinc couple on organic bodies; Part x., benzyl bromide, by Dr. J. H. Gladstone, F.R.S., and Alfred Tribe.—On the selective alteration of the constituents of cast iron, by Thomas Turner, Assoc. R.S.M.—On the existence of nitrous anhydride in the gaseous state, by Prof. G. Lunge.—On the reaction between nitric oxide and oxygen under varying conditions, by Prof. G. Lunge. Experimental evidence is given for the following conclusions:—(1) That when nitric oxide is mixed in the dry state with an excess of oxygen they combine exclusively, or nearly so, to form N_2O_4. (2) Dry NO and O_2, with an excess of the former, yield a large proportion of N_2O_3 along with N_2O_4, both in the state of gas. (3) In the presence of water, NO in the presence of an excess of O_2 is altogether converted into HNO_3. (4) If NO and O_2 meet in the presence of concentrated sulphuric acid, neither N_2O_4 nor HNO_3 is formed, even with the greatest excess of oxygen; but the reaction is—

$$4SO_4H_2 + 4NO + O_2 = 4SO_2(OH)(ONO) + 2H_2O.$$

The bearing of these facts on the theory of the vitriol-chamber process is then discussed. The author considers that N_2O_3, and not NO as hitherto assumed, is the carrier of oxygen, and that as long as any appreciable quantity of SO_2 is present, no nitric oxide is formed, the following being the reactions whereby the sulphuric acid is formed:—

$$2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2(OH)(O_2N)$$
$$2SO_2(OH)(O_2N) + H_2O = 2SO_2(OH)_2 + N_2O_3.$$

Anthropological Institute, May 12.—Francis Galton, F.R.S., President, in the chair.—The election of R. Brudenell Carter, F.R.C.S., was announced.—The Earl of Northesk exhibited a collection of Maori worked jade.—Mr. Sepping Wright exhibited a portrait in oils of King Tawhiao, in native costume.—Mr. J. H. Kerry-Nicholls, F.R.G.S., read a paper on the origin and manners and customs of the Maori race. The origin of the Maoris and the date of their arrival in New Zealand is unknown. The natives refer to Hawaiki as the fatherland of their race, but there is no reliable evidence to show where that land was situated. The lecturer believed that the Maoris emigrated from the Tonga islands to New Zealand, and referred to the resemblance between the two races, and to the affinity of the two languages. The word *tonga* occurred no less than sixteen times in the Maori tongue. The natives of the two countries when they met could converse with but little difficulty. The Maoris are of Malay stock, and came with the gradual spread of that race through the eastern islands of the Pacific to the more southern groups. The race is greatly on the decrease. In Cook's time (1769) the whole native population was estimated to exceed 100,000. In 1859 it only amounted to 56,000. In 1881 the number had decreased to 44,099, of whom 24,370 were males and 19,729 females. Calculating at the same rate of decrease, about the year 2000 the Maori race would be extinct. The principal diseases conducing to this decay were phthisis, chronic asthma, and scrofula, the two first being principally brought about by a half savage, half civilised mode of life, and the latter from maladies contracted since the first contact with Europeans. The native religion still exercises a widespread influence over the people; it consists of a kind of polytheism, a worship of elementary spirits and deified ancestors. They have a vague conception of a Superior Being, and believe in a *Reinga*, or heaven, and a *Po*, or Hades. The Maoris are divided into tribes whose members are bound together by the strictest union. The ownership of the soil is by tribal tenure, and each tribe holds a commercial interest in lands, forests, cultivations, and fisheries. The tribes dwell together in villages, and each *hapu*, or tribal family, cultivates a portion of land sufficient to meet its immediate requirements. The Maoris own about 15,000,000 acres of land in the North Island, not yet alienated to Europeans. The ownership of the soil was secured to the natives under the treaty of Waitangi, made in 1840. The tribes are governed by hereditary chiefs. In 1858 a king was elected by consent of the tribes under the title of Potatau the First. He was succeeded by his son, Matutaera Te Pukepuke Te Paue Tu Karato Te-a-Botatau Te Wherowhero Tawhiao, or Potatau II. This was the king who last year visited this country.

EDINBURGH

Royal Society, May 18.—E. Sang, LL.D., Vice-President, in the chair.—The first instalment of a paper by Prof. Chrystal, on the Hessian, was read. The chief object was to contribute to the theory of the number of intersections of a curve and its Hessian at any one point as depending upon the nature of the singularity at that point.—In a paper on the distribution of potential in a thermo-electric circuit, open or closed, Prof. Tait detailed the various real additions to our knowledge of the subject in their chronological order. He showed what is at present the most probable arrangement of potential in the circuit, and what classes of experiments remain to be made in order to settle the point.—A paper by Mr. Broom gave numerical details of the percentage contraction of volume when a saturated solution of a salt in water is diluted with an equal bulk of pure water.

PARIS

Academy of Sciences, May 18.—M. Bouley, President, in the chair.—On the results of errors caused by defective instruments in the determination of certain astronomical elements, by M. M. Lœwy.—On the radiation of heat during the night in connection with the normal lowering of the temperature during the months of April and May, by M. J. Jamin. This lowering of the temperature, often so destructive to the spring crops, is rightly attributed by meteorologists to nocturnal radiation, which the author finds attains its maximum about the months of April and May.—Note on the prophylactic inoculation recently practised on Rio de Janeiro against yellow fever, by M. Bouley. This experiment, first introduced by Dr. Domingos Freire, has since been carried out on a large scale under the control of the Government. Since the month of March, 1883, as many as 1109 persons of all ages, nationalities and conditions of life have been subjected to sub-cutaneous injections with the attenuated virus cultivated for the purpose. In some cases the injections were administered in houses where the scourge had a few hours before proved fatal to some of the inmates. Yet no misadventure of any kind has followed, and this preventive measure seems so far to have been attended by the best results.—Anatomical study of the fœtus of a spermaceti whale, by M. Pouchet.—Note on the annular protuberance regarded as the prime motor of the cerebral mechanism, the focus or centre of localisation for speech, the reasoning faculty, and the will, by M. Bitot. From his studies in cerebrology the author concludes, against the generally accepted opinion, that the third left frontal convolution is not the seat or centre of speech, which he localises in the annular protuberance. In the same region he also considers that the

intelligence and will are localised, so that even slight lesions of the central part of the annular protuberance destroy both the faculty of speech and of reason. He accordingly denies that the strictly psychic faculties are located in the cerebral cortex, which is the seat only of the organs of sense.—Note on the influence of the ship's motions (rolling and pitching) on the observations made at sea with the Renouf mercury level, by M. O. Callandreau.—Remarks on the observations of the planet Saturn made during the present year with the 0·22 refractor of the Meudon Observatory, by M. E. L. Trouvelot.—Note on the verification of the laws of vibration for elastic circular plaques, by M. E. Mercadier.—On the production of induction sparks at high temperatures, and on its application to the study of the spectrum, by M. Eug. Demarçay.—Composition and heat of combustion of a variety of coal from the Altendorf mines of the Ruhr Basin, by M. Scheurer-Kestner.—Note on the buccal membrane characteristic of the cephalopods, by M. L. Vialleton. From a microscopic study of this organ, the use of which has hitherto been unknown, the author infers that it should probably be regarded as a rudimentary arm.—A study of the chlorophyll action of plants as distinct from their respiration, by MM. G. Bonnier and L. Mangin. By "chlorophyll action" the authors understand the decomposition of the carbonic acid of the atmosphere by the green parts of vegetables in the light. This function they claim to have separated from that of respiration hitherto studied in connection with it, and here give the first results of their researches on the two physiological functions studied apart. — Note on the uric acid present in the saliva and in the nasal, pharyngial, bronchial, and vaginal mucus, by M. Boucheron. — On the influence of the lunar declinations on the displacement of the atmospheric currents, by M. H. de Parville.—On the earthquakes and volcanic eruptions which are of such frequent occurrence in Central America, by M. de Montessus. The author here communicates some of the results of a systematic study of these phenomena prosecuted for the last four years at San Salvador and neighbouring districts.—Note on some underground rumblings heard in the Island of San Domingo on August 28, 1883—that is, on the same day as the Krakatoa eruption, by M. Alex. Llenas.—Remarks on M. Gavoy's work on the "Morphology of the Encephalon," presented to the Academy by M. Larrey.

BERLIN

Physical Society, March 8.—Dr. Kayser showed a new electro-dynamometer constructed according to the directions of Prof. Bellati. Hitherto dynamometers consisted of two spirals—an external one, fixed, and an internal, movable, with bifilar suspension, which, being both successively traversed by the currents to be measured, produced a deflexion of the movable spiral that was proportional to the square of the strength of the current. The technical difficulties attending the construction of these instruments were very great, and Prof. Bellati had therefore substituted for the inner spiral a bundle of annealed iron wires hanging to a cocoon thread inside the fixed spiral. Seeing the annealed iron wires possessed no residual magnetism, they were at once magnetised by any current and their deviation was likewise proportional to the square of the strength of the current. This dynamometer was highly sensitive with weak currents. An intercalated telephone, the membrane of which was feebly struck, gave deviations of from sixty to eighty parts of the scale—a sensitiveness which till then had been attained by no dynamometer. Dr. Kayser at the same time showed a globular dynamometer, after the design of Fröhlich, in which the inner spiral was coiled up like a ball, and a Siemens torsion dynamometer for strong currents in which the inner spiral was fixed, the outer movable, and the deviation read by a torsion apparatus. In the discussion which followed the speaker stated that the measurements hitherto taken had proved great precision on the part of Prof. Bellati's dynamometer.—Dr. Dieterici reported on the results of an investigation carried out by him in the last session into the electric residuum. The phenomenon had been experimentally examined by Prof. Kohlrausch, and theoretically treated by Riemann; but the formulæ set up by the latter did not correspond with the results of the experiments, and therefore the speaker undertook a new treatment of the subject. The experiments were carried out with a condenser, the lower plate of which was connected with the earth, the upper with a small mercury cup. A metal hoop led from the latter to a second mercury cup which on one side communicated through a metallic wire with one half of a quadrant electrometer, and on the other side through a second hoop with a third mercury cup. The second half of the electrometer and the third mercury cup were in permanent communication with the earth. The two hoops could alternately be raised out of the quicksilver by cords passing over a pulley or let down. If the first hoop were lifted up, the electrometer was conducted to the earth, the upper condenser plate, on the other hand, was isolated, and could now be charged. Thereupon the hoop was let down; the condenser now stood in connection with the earth and discharged itself. Finally, if the second hoop were raised, the condenser was connected with the electrometer, and both isolated. The residuum after the discharge could now be measured. The charge was effected by the highly constant dry Daniell cells (according to Herr v. Beetz), and in the different series of experiments the continuance of the charge was varied between five minutes and twenty-four hours, as the strength of the current was likewise varied. For each duration and strength of charge the residuum was determined in its course in respect of time in a series of individual determinations. The dielectric of the condenser was a paraffin plate and air. The experiments showed that under a charge of short duration—say, five to ten minutes—the residuum rose very rapidly with the time, and soon attained its maximum; so that its curve mounted very steeply and soon ran parallel to the abscissa of the time. Under a charge of long duration, again, the curve rose more slowly indeed; had, however, always greater values, and lay with more flat bend over the curve of short charge. On changing the strength of the current the electric residuum was always in proportion. Dr. Dieterici now treated the theory of the phenomenon, and briefly sketched the course of its theoretic investigation, which, under the assumption that the dielectric was infinitely thick—that is, neglecting the influence of the thickness—led to formulæ which very well explained the experimental results. The formulæ were, however, only empirical: they did not allow the determination of the constants of the phenomenon. In conclusion, the speaker dwelt on the analogy of the electric residuum to the phenomena of heat, which had also under theoretic treatment found its expression by application of heat-formulæ, and to the elastic after-effect which Prof. Kohlrausch had already pointed out.

ROME

Reale Accademia dei Lincei, March 1.—Fossil remains of *Dioplodon* and *Mesoplodon*, found in the Upper Tertiary in Italy.—Signor Capellini made a communication concerning a paper of his, in which he illustrates and describes the fossil remains of Ziphioids with elongated belemnite-shaped beak, found in various places in Italy. These remains belong to the following species:—*Dioplodon longirostris, D. gibbus, D. tenuirostris, D. bononiensis, D. medilineatus, D. senensis, D. lavelcyi, D. meneghinii.* A few remains are ascribable to the genus *Mesoplodon*. The specimen described by the author add seven species of Ziphioids to the fossil cetaceans found in Italy; four of these being already known in the Upper Tertiary of Belgium and England, while the three others are entirely new. It must be remembered that before 1875 no fossil remains of Ziphioids were known to exist in Italy. From that time till now there have been discovered about ten species, some of the remains belonging to which are of great importance to palæontology and stratigraphical geology.—On the mineral volcanic *ejectamenta* found in the east of the Lake of Bracciano.—Signor Strüver communicated an abstract of a memoir, in which he explains how, after long and fruitless searches, there had been found within the last few years, in the region lying to the east of the Lake of Bracciano, numerous mineral *ejectamenta* similar to the bombs of Monte Somma, and the mineral aggregates of the Monti Albani, of Pitigliano, and of Lake Laach, in Germany. These *ejectamenta* are found between strata of tuff or *lapilli* and fragments of various rocks. Among the numerous minerals composing the aggregates, Prof. Strüver draws special attention to the sarcolite, a mineral hitherto found but rarely, and that only on Monte Somma. The *ejectamenta* in question present, in respect of the extraordinary diversity in their forms, great analogy to the aggregates of a like nature found in the other places mentioned, but nevertheless have a local stamp of their own, and their diversity is in correspondence with the position of the volcanoes from which they were ejected, and the rocks of the regions in which these volcanoes were active. Prof. Strüver draws attention to the fact that these aggregates must at one

time have been united together and formed a single deposit, and shows how that excludes the hypotheses that they were formed in the place where they are now found, and that they are derived from deposits anterior to the period of volcanic activity. —On the relations between the maxima and minima of the solar protuberances, and the maxima and minima of the diurnal oscillation of the declination magnet. Prof. Tacchini, after giving an account of his own researches already published, on the maxima and minima of the sunspots and solar protuberances, referred to the observations of Prof. Schiapparelli on the values of the range of diurnal oscillation of the declination needle, and from the comparison of the two sets of observations, it appears that of late years the connection between the solar protuberances and terrestrial magnetism is more strikingly manifest. These and other similar observations, Prof. Tacchini added, corroborate the idea entertained by himself and some others, that electricity plays the chief part in the solar protuberances, and that electricity is able to produce corresponding magnetic disturbances on our globe. It may therefore be inferred with certainty that the phenomena of the sunspots, the solar protuberances, and terrestrial magnetism are closely connected together, and that by means of one of these sets of phenomena it is possible to determine with tolerable precision the epoch of the other two. In dealing, however, with phenomena of rather long period continuous observations for at least half a century are necessary to make our researches complete.—On the spectroscopic observations of the limb of the sun and the solar protuberances made in 1881 and 1884 at the Royal Observatory of the Capitol.—Prof. Respighi laid before the meeting some considerations of his own, based on observations made in his own observatory, and leading him to conclusions different from those of Prof. Tacchini. He maintains that the maximum of solar protuberances occurred towards the end of the third quarter of 1881. Holding that the sun-spots are due to partial cooling of the surface of the sun, and the protuberances to the escape of gases from the interior, Prof. Respighi believes that such perturbations are not of a nature to occur in periods, even though they retain a certain relation among themselves, and still less can he admit any connection between the maxima of the solar protuberances and the elements of terrestrial magnetism.—Meteorological observations made by Signor P. Orlandi, a physician of Rome, during the years 1809–1820. Signor Narducci called attention to a manuscript in the Biblioteca Angelica, containing some interesting medico-meteorological observations made by Signor Orlandi, a medical man belonging to Rome, between the years 1809 and 1820. These observations are copious and complete, having been made daily. They also include notices of movements of the earth's crust and inundations of the Tiber. Signor Narducci mentioned that Dr. Orlandi was a man of science and writer of great renown in his time. Large extracts from the observations of Orlandi are to be published in the *Annals* of the Central Office of Meteorology, and they will thus be able to be compared with those published by distinguished astronomers belonging to the same epoch.—On the last and recent maximum of sun-spots and solar protuberances. Prof. Riccò gave an account of his own observations made at Palermo on the phenomenon of the solar protuberances, which was so important on account of its coincidence in time with very singular manifestations of the solar maculæ. Prof. Riccò deduced from his own observations, harmonising, as they do, with those of Prof. Tacchini, that, starting from the last maximum in the period of eleven years, the number of the protuberances went on increasing till 1881, when a first maximum occurred. It was further verified that the absolute maximum fell between the end of 1803 and the beginning of 1804, and that on that occasion the maximum of protuberances continued beyond that of the sun-spots. Finally, leaving out of account secondary oscillations, Prof. Riccò asserted that a parallelism may be observed between the frequency of sun-spots and protuberances, the principal maxima and minima of both phenomena coinciding with one another.—On the relation between the maxima and minima of the sun-spots and the maxima and minima of the diurnal variations of the declination needle observed at Genoa. Prof. Garibaldi has made a comparison between the normal compensated series of groups of sun-spots observed by Prof. Tacchini during the period 1877–84 and the series of diurnal variations of the declination needle observed at Genoa during the same period. From the mirror-tracings of the author it appears that the two series agree perfectly. Hence, considering that the observation of the sun and its spots depends upon the clearness of the sky, while the magnetic influence of the sun can always act, and observations of magnetic changes can always be easily made, Prof. Garibaldi arrives at the conclusion that the epochs of maxima and minima of the sun-spots may be inferred from the indications of the declination needle when direct observations are not obtainable.—Action of nascent hydrogen on methyl-pyrrol. Drs. Ciamician and Magnaghi having already ascertained by previous researches that *pyrrol* is converted into an alkaloid called *pyrrolin* under the action of nascent hydrogen, communicated a preliminary notice of the experiments commenced by them with the view of increasing the number of bodies belonging to the pyrrolin series, experiments in which they studied the action of nascent hydrogen on other derivatives of pyrrol.—On a method for the electric calibration of a metallic wire. Dr. Ascoli, pointing out that in accurate measurements it cannot be assumed that the length and resistance of a wire stand in a constant relation to one another, described a very simple and easily applied method of his own by means of which a wire can be quickly and perfectly calibrated without the aid of special instruments and without accessory measurements. By the construction of a curve the resistance of the corresponding piece of wire is obtained from the area limited by the curve.—Other communications: Prof. Besso presented a first note on a class of differential linear equations of the fourth order and on the equation of the fifth degree.—Prof. Gomes-Teixeira furnished a paper on the determination of the algebraic part of the integral of rational functions.—Prof. Riccò made a preliminary note on the observations made by him on red glows.—Dr. de Franchis offered various considerations on some relations between the velocities of efflux, the specific heats, and the mean squares of the molecular velocities of gases.

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